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THE UNIVERSITY OF ALBERTA

A Socio-Economic Analysis of Adoption of European Breeds of Dairy Cattle in Southern Kakamega, Kenya

by

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ABSTRACT

This study undertakes an examination of socio-economic factors affecting the adoption of European (improved) breeds of dairy cattle by small scale farmers in southern Kakamega, Kenya. The factors assessed included the nature of these dairy breeds, (Friesians, Guernseys, Ayrshires and Jerseys) compared to that of indigenous cattle, the resource base on these farms, the nature of the farmers and extension services available to farmers in Kakamega district. The theory of the process of adoption of a new innovation provides the framework for this study. The study is important because there is a definite need for increased milk production in this densely populated and milk deficit area. The major objective of the study was to determine the reasons why farmers in southern Kakamega have been slow in adopting improved dairy breeds of cattle.

The study uses both survey and published data. The survey data were obtained from a formal oral interview of thirteen adopters and forty non-adopters of improved dairy cattle. The published data were mainly from the Ministry of Agriculture and Ministry of Livestock Development.

The results of the study show that a number of economic and technical factors appear to have discouraged the adoption of improved cattle breeds in the area. Improved dairy breeds which have been imported into lowlands areas of Kakamega from the cool, high altitude areas of Kenya have been more susceptible to diseases and heat stress and do not

appear to withstand the low levels of feed intake compared to the local zebu cattle. Consequently, many farmers in this area did not seem to perceive substantial net benefits from adopting improved cattle.

Another set of factors which have discouraged the adoption of improved cattle breeds is the narrow resource base of farmers in the region. The average farm size was about 5 acres and much of the land was allocated to food crops for family consumption and to cash crops. Improved dairy cattle competed for the limited resources on these farms, while local cattle were complementary and supplementary in the use of resources. In addition, most farmers and hired workers did not have the formal schooling or farmer training required to manage improved cattle satisfactorily.

A third set of factors which have slowed the adoption of improved cattle was the inadequate extension services at the farm level concerning general dairy management, disease control and artificial insemination.

One recommendation of this study is that a research program should be undertaken to develop an appropriate dairy breed which is suitable to the conditions of farmers in this region. Also, it is suggested that a research program should be undertaken to develop relevant recommendations for the management of local cattle. A third recommendation is that better training and extension services should be provided to dairy farmers in the Kakamega region.

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I. INTRODUCTION

A. The Purpose of the Study

This study undertakes an analysis of the socio-economic factors affecting adoption of improved dairy breeds on small farms in Southern Kakamega District of Kenya.[1] It is expected that the results of this study will aid in the planning of dairy research and extension programmes that take into account the socio-economic constraints of small scale dairy farmers. It is also expected that appropriately designed research and extension programmes will facilitate a faster adoption of improved dairy cattle breeds to achieve the Government of Kenya's objective of self sufficiency in milk production.[2]

The remainder of this chapter is divided into four sections. The first deals briefly with the general agricultural setting of Kenya. The second section outlines the background of the dairy farming sector in the country, with the main focus on the small scale farms. This section highlights the problem and the objective of the study. The third section of this chapter outlines the hypotheses to be tested in the study. The final section outlines the

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[1]The Kenyan farming sector is divided into large scale farms and small scale farms. Large farms are defined as those over 50 acres and small scale farms are those less than 50 acres, with an average of about 5 acres. Small farmers number about 1.7 million, and 60 per cent of these are involved in subsistence farming (Hill, 1981).

[2]The Government of Kenya will be referred to as the Government.

organization of the subsequent chapters of this study.

B. Agriculture in Kenya

The agricultural sector plays a significant role in the economy of Kenya.[3] Approximately 90 per cent of the total population can still be classified as rural and are directly dependent on agriculture for their existence .[4] Hill reported that the agricultural sector accounted for about 35 per cent of total employment in the private sector and 14 per cent in the public sector. He also reported that the agricultural sector contributed 30 per cent of gross domestic product in 1979. In addition, the agricultural sector also supports the food processing industry (canning, milling, dairy processing, etc..).[5] Maitha has reported that 80-90 per cent of the total exports of Kenya are agricultural (mainly coffee, tea, pyrethrum, and sisal). Other commodities produced are sugarcane, maize, wheat, barley, sunflower, and livestock (sheep, goats, cattle,) and livestock products.

The agricultural products come from two distinct sectors, the large scale and the small scale farms as defined above. Between 1964 and 1974, about 40-60 per cent

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[3]The agricultural sector is broadly defined to include both the agricultural production and household sector.
[4]J. T. Hill (ed.), *Agriculture Abroad* Vol.36 No. 3 (June, 1981), 8-12.
[5]J. K. Maitha, "The Kenyan Economy". In: J. Heyer, J. K. Maitha, and W. M. Senga (Ed.), *Agricultural Development in Kenya: An Economic Assessment*, (Nairobi: Oxford University Press, 1976), pp. 35-53.

of the total gross marketed agricultural commodities in Kenya were from large scale farms, and the balance from small scale farms.[6]

C. The Problem and Its Setting

Dairy farming is an integral part of the agricultural sector in Kenya. Traditionally the local Zebu cattle have been kept in Kenya for several purposes (for meat, milk, and social obligations). From the 1920s, European dairy cattle breeds (Friesian, Ayrshire, Guernsey, and Jersey have been imported into Kenya. These have been crossed with the local Zebu cattle to produce breeds relatively resistant to diseases and adaptable to ecological conditions in Kenya.[7] Stotz (1980) has shown that about 1 million improved breeds of dairy cattle have been produced by upgrading of Small East African Zebu with the European dairy breeds.[8] The same author has noted that about 90 per cent of the improved cattle herd is found in the mixed farming areas of Kenya's Highlands (large scale farms).

Before the mid 1950s, grade cattle were restricted to the large scale farms only. Thus, the production of milk for the commercial sector has mainly been from the large scale farms. For this reason, the focus of dairy research and

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[6] op.cit., (1976), p. 57.
[7] These will be referred to as improved dairy cattle breeds.
[8] D. Stotz, "Grade Dairy Cattle, an Attractive Innovation for Small-Scale Farmers in the Highlands of Kenya," *Quarterly Journal of International Agriculture*, Vol. 19, No. 2 (April-June 1980), pp. 147-160.

extension, and marketing services has been towards the large scale farms. The objective has been to increase milk production for the urban market.

From 1955 onwards, dairy farming has been on a dualistic pattern: (1) large scale and (2) small scale. The objective has been to increase milk production for the urban and the rural markets. Stotz (1979) has reported that the small holder dairy herd was estimated between 600,000 and 1,460,000 while the dairy herd on large scale farms was 250,000 by 1976.[9] Stotz (1980) found that small holder dairy herd had increased by about 160,000 head between 1963 and 1978.[10]. He also found that improved cow population has grown by about 50,000 head per annum or about 7 to 10 percent including expansion of existing herds as well as the introduction of improved cattle on un-improved-cattle-keeping farms. Furthermore since 1960, a yearly average of about 10,000 new smallholders adopted improved dairy cattle (Figure I-1). From the same figure, it is noted that after 1960, large dairy farms decreased as small farms increased in number. Since then, dairying on small farms has been encouraged and supported through a number of Government policies and activities. These have included land adjudication, animal disease control measures, availability of credit and artificial insemination.

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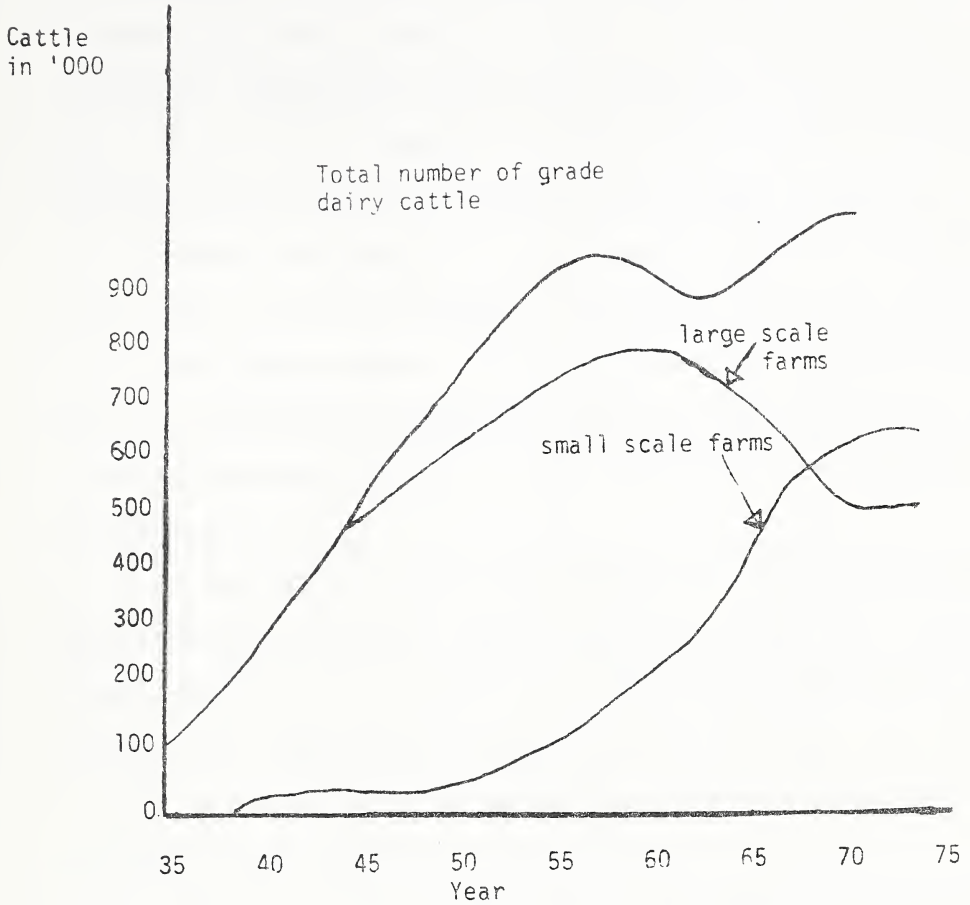
[9]D. Stotz, *Small-holder Dairy Development in Past, Present and Future in Kenya* (Hohenheim, 1979), p. 2.
[10]D. Stotz op. cit., 1979, p. 148.



Adapted from: D. Stotz, "Grade Dairy Cattle, an Attractive Innovation for Small Scale Farmers in the Highlands of kenya", Quarterly Journal of International Agriculture Vol. 19 No. 2 (April-June, 1980), p. 147.

Figure I.1 Dairy Cattle Development by Type of Farm

The importance of milk production in the economy of Kenya cannot be overemphasized. First, Kenya is a net importer of dairy products. Second, milk products are important components of human nutrition, particularly for the children of all ages. In 1980, the President of Kenya introduced an elementary school milk scheme in the country. This scheme provides milk to all public schools in Kenya. In that year, a total of about 31 million litres of fluid whole milk were fed to about 4 million school children (grades 1 to 7).[11] The future demand for milk to meet this requirement as well as commercial and rural consumption is likely to increase.[12]

Third, dairy farming contributes to the agricultural gross domestic product (GDP). Stotz has shown that there are about 300,000 dairy farmers in Kenya, contributing 17 per cent of the agricultural gross domestic product. [13] Although a great deal of the milk which is produced is not marketed through formal channels, approximately 171 million litres of milk (valued at 310 million Kenya shillings) was marketed by Kenya Co-operative Creameries (K.C.C.).[14] Lastly, dairying can be easily made compatible with the available cropping

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[11] Kenya, Ministry of Livestock Development, *School Milk Programme:* (January 1981) p. 1.
[12] It is anticipated from the same report that about 34 million litres of whole milk will be required to feed approximately 4.4 million school children in the near future.
[13] D. Stotz, op. cit., (1979), p. 23.
[14] Eight Kenya shillings are equivalent to one Canadian dollar.
K.C.C. is the sole marketing agency in the formal dairy market.

systems in Kenya. This means that there is a greater need for the Government to increase milk production potential by introducing improved cattle.

Results of surveys carried out on large scale farms in Trans-Nzoia district of Kenya between the period 1967 and 1971, indicated problems of ownership and organization compounded by lack of both capital and managerial skills.[15] Stotz has reported that newly established large scale dairy farms need improvement in feeding and disease control.[16] He has argued that the large dairy farms that have shown improvement have required high level of management provided by parastatal bodies like Agricultural Development Corporation. Furthermore, the number of European dairy cattle kept on these farms have fallen steadily from 1959 to 1967; since then they have remained constant. By 1976, there were 1900 large farms in the mixed farming areas keeping an average of 90 dairy cows each and producing about 40 per cent of the milk for urban market. Thus, large scale farms still play an important role in the Kenya milk industry, though their share in total production has decreased in favour of the smallholder sector. Though management on large dairy farms has improved, milk yields and herd coefficients are still poor compared to performance level before 1960, when European settlers managed these farms. It can be said

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[15] Kenya, Central Bureau of Statistics, Ministry of Finance and Planning, "An Economic Survey of African Owned Farms in Trans-Nzoia, 1967/68 to 1970/71" *Farm Economic Survey Report* No. 28 (Nairobi: Kenya Documentation Centre), pp. 47-51.

[16] D. Stotz, op. cit., (1979), pp. 4-17.

that the transfer of management to African farmers with limited skills and experience in dairy management was a major problem. It would be suspected that smaller farms would require less expertise than these large farms.

Despite the aforementioned importance of milk production on small farms, the rate of adoption of new dairy cattle breeds seems to be slow and in some cases this rate may be non-existent. The dairy research that has been carried out so far seems to favour the large scale farmers. Further, the recommendations given have tended towards physical and biological factors, and little or no emphasis has been placed upon social and economic environment of the farming systems.

It is only recently that the Government has started devoting efforts to examining the problems that face the small farm sector. These efforts are indicated in the latest development plan (1979/83) that emphasis be placed on research which is relevant to the circumstances of the farmers.[17] It is also stated in the same plan that:

> "any new technologies must be suited to the on farm situation. The aim is to incorporate socio-economic constraints into the design of technology and to assess the farmer's ability to introduce and adopt new varieties and technologies in farming".

Stotz reported that improved dairy production in Kenya had

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[17] Kenya, *1979-1983 Development Plan*, Part 1 (Nairobi: Government Printers), pp. 211, 229.

become primarily a smallholder activity by 1977, although the initial husbandry problems were substantial.[18]

It is worthy noting that the key factor in dairy development in Kenya was the favourable climate of the highlands and the powerful European dairy sector that inhibited the participation of smallholders.

In this study the focus is on the analysis of the role of technical research and extension on the adoption of the improved dairy cattle breeds on small scale farms in southern Kakamega. As it will be seen in Chapter III, southern Kakamega includes an area that was considered for a special rural development project in the mid seventies. During this period the emphasis was placed upon crop and dairy production. Extension services were considered more adequate than in other areas in the district.

However, in this area, dairying has not been successful. It might be expected that with a high population density in this part of Kakamega, milk demand would be high especially with the school milk scheme in force. Apparently, the problem exists concerning the state of knowledge appropriate to dairy farmers in this area. Where the knowledge exists, it is likely that there is a gap between the available dairy research recommendations and what the farmers can actually achieve.

The problem therefore is that despite the Government effort to develop dairying in this area, small scale dairy

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[18] D. Stotz, op. cit., (1979), p. 14.

farmers in Southern Kakamega do not adopt recommended breeds of cattle. This study aims at finding out why these farmers do not keep improved cattle for milk production. The objective of the study is geared towards identifying factors which influence the adoption of dairy research in southern Kakamega.

D. Hypotheses

Broad hypotheses postulated are associated with resource base, breed type, extension services, and social set up of the farmers in southern Kakamega. These general hypotheses contain specific variables which are considered to have significant effect on the adoption of European breeds of dairy cattle in southern Kakamega.

1. Need for cash and non-cash capital limits the farmer's ability to invest into an improved dairy cow.
2. Shortage of grazing land is a constraint in the area, as cropping and dairying compete for this land.
3. That skills and knowledge about managing improved cattle are limiting, as these cows require higher level of management than what the farmer can afford.
4. Labour for improved dairy farming is a constraint in peak periods. Labour for watering and feeding improved cow is an extra cost to the farmer adopting this innovation.
5. Recommended cattle breeds for the area are not available within the area studied. The inavailability of a

suitable breed for the area poses problems of risk and uncertainty to farmers with limited managerial skills.

6. Nature of social system does not allow it. Traditional values attached to local Zebu cattle may hinder the introduction of new breeds.
7. Facilities and supporting services are inadequate. Lack of facilities such as cattle dips, hand sprayers, spray races, central watering holes, and adequate veterinary services hinder the establishment of improved dairy breeds in this area.

These hypotheses are tested using primary and secondary data. Primary data are obtained from survey of 53 farmers in the study area. Secondary data are obtained from the Government publications and related literature reviews. The methods of testing the hypotheses include frequency distribution and cross tabulation. The goodness of fit is tested using the Chi square technique.

E. Organization of the Thesis

The theory of technology transfer is reviewed in chapter two while chapter three deals with sources of data and methodology procedures followed in gathering these data. Chapter three also outlines the physical features of the study area. Chapter four focuses on the available dairy research and extension services in Kakamega district. Chapter five deals with the analysis and results of the data used for the study. Chapter six contains conclusions and

recommendations. This chapter brings out extension and research programmes that the Government should include in future development plans for small scale dairy farmers of similar potential.

II. THE THEORY OF TRANSFER OF NEW TECHNOLOGY

A. Introduction

Peterson and Hayami have noted that technical change has been one of the rapidly growing areas of study within agricultural economics since the second world war. [1] These authors point to two main problem areas related to technical change that have concerned agricultural economists. One problem has been the resulting surplus of agricultural products in many developed countries which agricultural economists have attributed in large part to the application of new technology. The other problem has been the difficulty that developing nations have experienced in increasing agricultural output. The concern has been to investigate the role of increased technical change in alleviating food shortages of agricultural products in these countries. Stevens has stated that new technology in agriculture is a useful tool for transforming traditional agriculture into modern agriculture in developing countries.[2]

Despite the role attributed to new technology in the transformation of traditional agriculture, it seems that the impact of new technology on agricultural production in

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[1]For a review of literature on technical change, see W. Peterson and Hayami, Technical Change in Agriculture." In: Lee R. Martin (ed.), *A Survey of Agricultural Economics Literature* Volume 1 (Minnesota: University of Minnesota Press, 1977), pp. 497-540.

[2]Robert D. Stevens, *Tradition and Dynamics in Small Farm Agriculture: Economic Studies in Asia and Latin America* (Ames: The Iowa State University Press, 1977), 247-250.

developing countries has been minimal. In this chapter, the process of social change associated with a new technology is described. This involves outlining the sources of new technology in agriculture, describing the diffusion of that technology, its adoption or rejection by potential users, and the consequences of the technology to these receivers.

The focus here is on socio-economic factors affecting the adoption of new technologies in agriculture. The objective is to set a theoretical framework for evaluating the transfer of a new agricultural technology to small scale farmers in southern Kakamega, Kenya.

B. Definition of Technology

A new technology can be defined as a material, idea, design or capacity that can be used to effect changes in the production process. Technical change is defined as the production of greater output per unit of input (Peterson and Hayami, 498). This is illustrated in Figure II-1. In general, technical change is viewed as an upward shift in the production function (Figurer II-1) due to the application of the new technology. That is, the impact of a new technology is to increase productivity of existing resources.

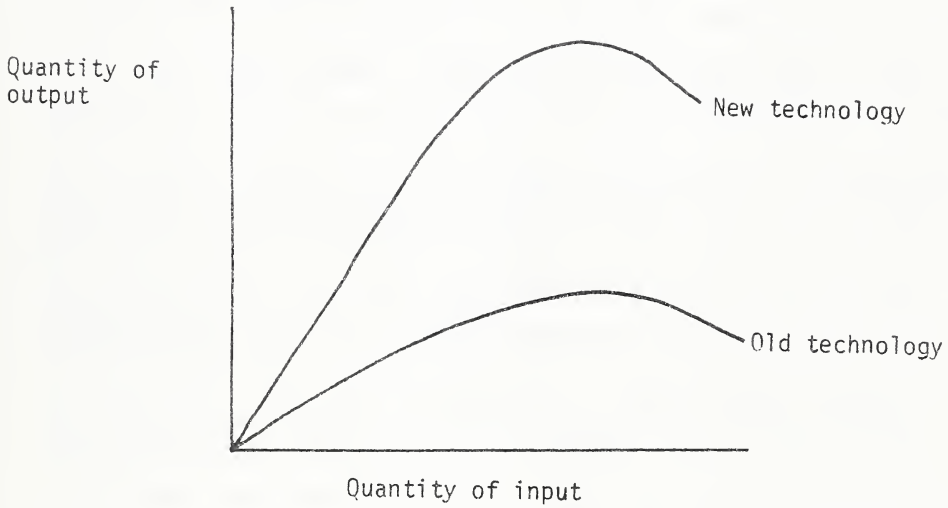

Figure I.1 The Effect of New Technology on Agricultural Production

C. Sources of New Technology in Agriculture

Stevens has stated that a new technology in agriculture can originate from agricultural research inside the agricultural sector, and also sources outside of agriculture itself.[3]

Hayami and Ruttan have defined three main sources of new technology for agriculture in developing countries, namely direct, adaptive, and comprehensive research. The direct source involves implantation of a technology from one country or region to another.[4] In this case, it is assumed that the technology is appropriate for the user. The adaptive source of technology involves testing a technology developed elsewhere for its appropriateness to the user, modifying it accordingly to suit local conditions. The comprehensive research approach as a source of a new technology requires a comprehensive research program within the country in order to develop a technology suitable to local factors. This latter procedure can be costly and may duplicate research results already developed elsewhere. Whatever the method of developing a new technology, it is essential to transfer the new and proven technology to its potential users, which will be farmers in this case. The next section describes the theory of the process of diffusion and adoption of a new technology.

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[3]R. D. Stevens, *op. cit.*, 247-250

[4]Y. Hayami and V. R. Ruttan, *Agricultural Development: An International Perspective* (Baltimore: John Hopkins University Press, 1977) 175.

"Diffusion is the way by which new ideas are communicated to the members of a social system".[5] Diffusion is a special case of the more general communication's model. The adoption process on the other hand is the "process through which an individual passes from first knowledge of a new technology to a decision to adopt or reject that technology". Both of these important processes will be described in more detail below.

The diffusion process as a special kind of communication can be illustrated in Figure II-2. Elements in the the usual communication model are compared to those in the diffusion process. Diffusion differs in that it is concerned with messages which are new ideas communicated to potential users in the hope that they will adopt these new ideas or innovations. Thus, while ordinary communication includes all types of messages, diffusion is a special type of message which involves potential benefits to the receivers as well as a degree of risk that the innovation will make them worse off.

It is obvious that communication of new innovations to potential users can be a very complex process. Seldom does the message pass directly from developer of the innovation, to potential users. More often it is a multi-step process, involving several senders and receivers, resulting in a high probability of miscommunication about the new technology.

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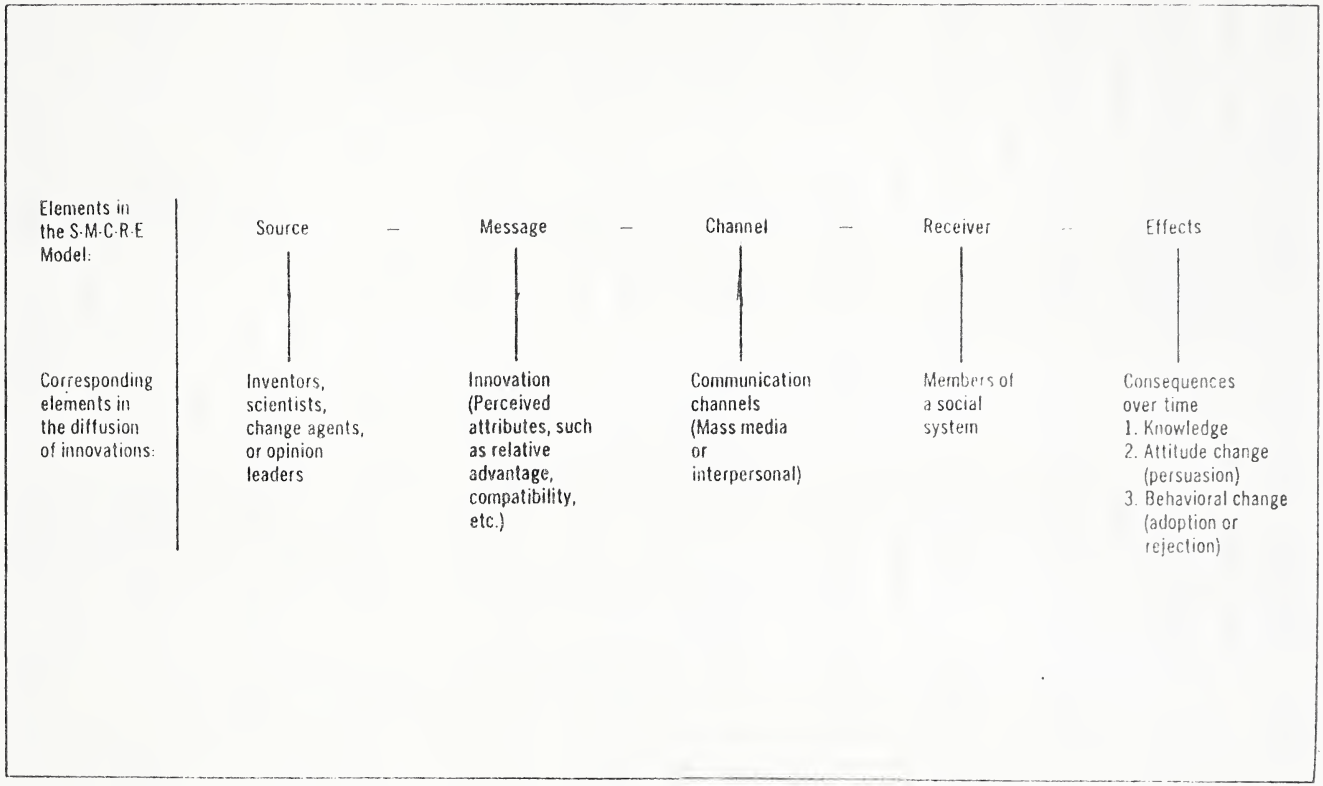
[5]E. M. Rogers and F. F. Shoemaker, *Communication of Innovations* (London: Collier Macmillan Publishers, 1971), pp. 7, 18-21.

Figure II.2 Elements in the Process of Diffusion

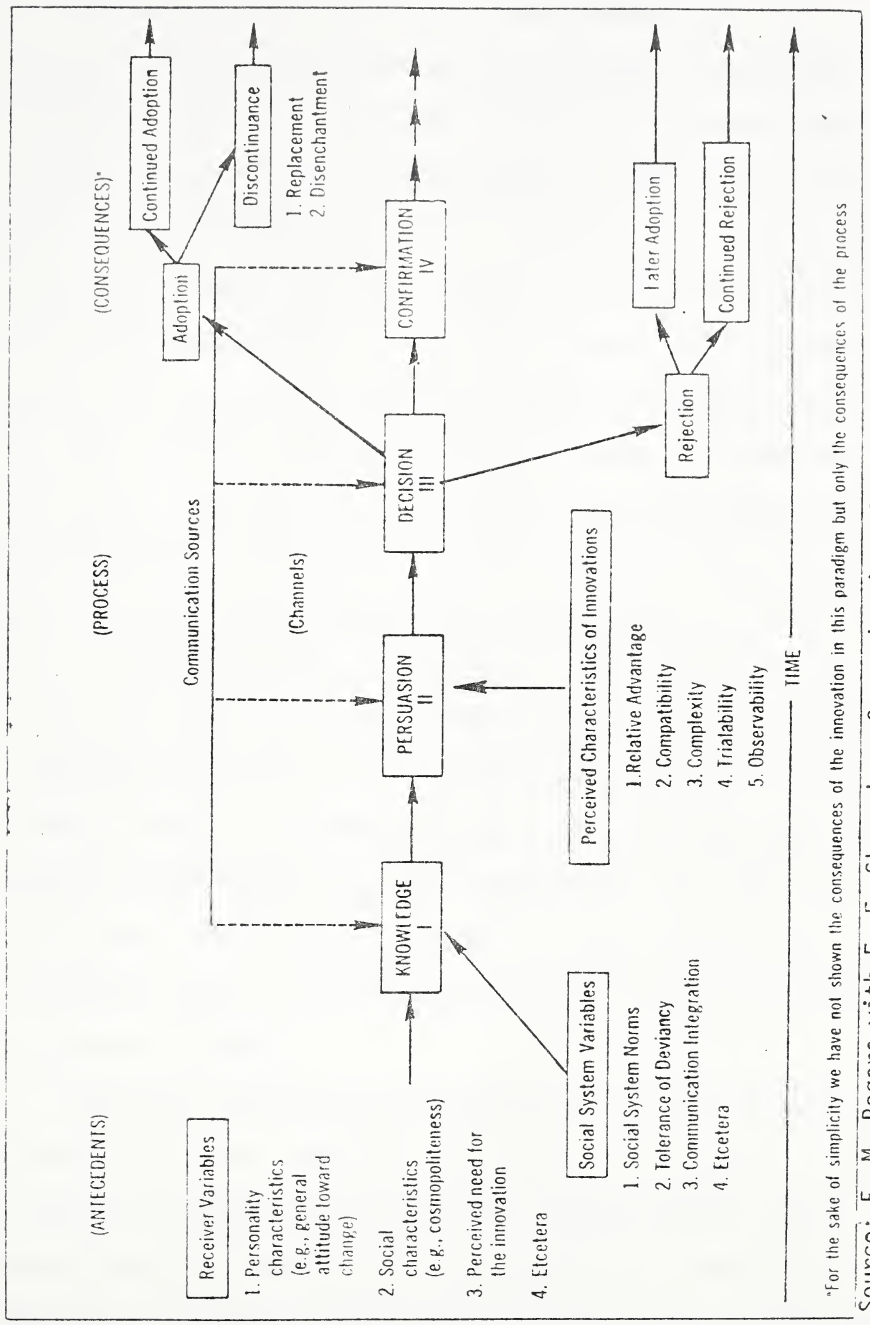


Source: E. M. Rogers With F. F. Shoemaker, Communication of Innovations (London: Collier Macmillan Publishers, 1971), 20.

Furthermore, potential users have been found to differ in their receptiveness to different messages. Some for example, some place high confidence in professional sources, while others give high credibility to information received from neighbours. Research has also shown that the most effective communication channel is determined to a significant degree, by the stage of the potential user in the process of deciding whether to adopt or to reject a new technology.

Consequently, the diffusion process is an extremely important conceptual model for a change agency to consider, when developing and operating a programme of technology transfer, where new innovations arising out of research or elsewhere, are being diffused to potential users via various channels and methods. Diffusion is much more than a simple one-channel communication to potential users from the research source. It is many faceted phenomenum requiring careful study of the potential adopter, and available communication channels to ensure that the most appropriate methods are utilized for the particular situation at hand.

While the diffusion process describes the ways in which information about a new technology flows from its source to potential adopters the adoption process deals with the adopter himself. It describes the sequential steps he goes through from the time he first hears about a new technology until he decides to adopt or reject it. One of the more commonly used adoption models has been developed by Rogers and is shown in Figure II-3.



Source: E. M. Rogers with F. F. Shoemaker, Communication of Innovations (London: Collier Macmillan Publishers, 1971), 102.

Figure II.3 The process of Adoption

The innovation-Decision process shown in Figure II-3 consists of four main functions or stages: knowledge, persuation, decision and confirmation. The knowledge stage is when the individual is exposed to the innovation and gains some knowledge about how it functions. During the persuation stage, the individual forms a favourable or unfavourable attitude toward the innovation. The decision stage involves an individual's choice to adopt or reject the new idea. Lastly, the confirmation stage is when the individual seeks to reinforce the innovation-decision he has made, but he may reverse his previous decision if exposed to conflicting messages about the innovation.

It will be useful to examine those variables in the Innovation-Decision process which might influence the rate of adoption of particular innovations, as this is the ultimate object in change agency work. Influencing variables can be viewed under four main headings: (1) receiver variables; (2) social system variables; (3) innovation variables; and (4) diffusion variables. Each of these will be covered briefly.

Receiver variables are personal factors unique to the potential adopter himself, which have influence on the rate at which he adopts new technology. Researchers have classified receivers into: (a) innovators; (b) early adopters; (c) early majority; (d) late majority and (e) laggards, based upon their relative length of time to adopt a new and proven idea. Each class is identified with unique

personal, social and economic characteristics which, in turn, determine diffusion strategies which are appropriate. Among the characteristics analyzed are attitudes and values, skills and knowledge, interaction with the community, size of farm operation, and sources of farming information.

Social system variables include pressure from the individual's peer group and community which may have effect on his acceptance or rejection of the new idea. Sanctions such as redicule or exclusion are used to punish or reward the potential adopter. Analysis of social systems can frequently give the change agent or extension worker, a better basis for the way in which his program can be most effectively organized.

Innovation variables are perhaps the most important in this study. The nature of the innovation itself frequently has the greatest bearing on its adoption rate. Relative advantage or profitability is the most important in the eyes of many potential adopters. The innovation must not only appear profitable, but it must be more profitable than other competing alternatives. Furthermore, it must be compatible with the values and objectives of the receiver. Complex innovations take obviously longer to adopt, as do innovations where the benefits are not easily seen (such as business analysis). Innovations which are divisible so that small trials can be carried out will be adopted more quickly than an all-or-nothing situation where the costs of being wrong may be very high. An analysis of the innovation in

terms of the above variables will provide the change agent with guide lines for the type of information and activity which needs to accompany the innovation, as the diffusion process unfolds. This may involve benefit-cost charts and graphs, or demonstrations on the potential adopter's farm.

Diffusion variables include the special kinds of communication messages and channels to which receivers are exposed. These variables can influence the rate of adoption of the new ideas. Further, the selection of appropriate channels and messages to match the particular situation, is a vital component of the job of the change agent. He must be aware that each adopter category has its own most common information channels or sources. Furthermore, it has been demonstrated that potential adopters tend to utilize different information sources and assistance for different steps and stages in the innovation-decision or adoption process. Mass media obviously are most useful at the awareness stage, while supplier representatives, excel when testing and special skills are required to try out the innovation. The public agency role and importance has been extensively reviewed and the conclusion is that its role as a resource linker, reinforcer, process helper and catalyst is all important in the whole adoption process. This assumes that it purposely plans the technology transfer process in its area of jurisdiction, rather than letting it happen randomly.

D. Summary

This description of the diffusion and adoption models suggests that there are many complex factors involved in effective technology transfer. A special factor in developing countries should be mentioned. This is the matter of risk. Stotz has noted that the attractiveness of the adoption of the innovation is assessed by farmers in terms of increased income and risk reduction. [6] Collinson has shown that small scale farmers can rapidly adopt an innovation if it enhances the productivity of the farming system and improves the food supplies without excessive risk.[7] Thus, the perceived attributes of an innovation have direct influence upon the rate of its adoption and spread.

Another important factor in the transfer of technology is the role of the change agent and agency. Petersen has contended that selection of appropriate channels and messages to match the particular situation is a vital part of the change agent's job.[8] Petersen has also emphasized that potential adopters tend to utilize different information sources and assistance for different steps in the adoption process. It is worth noting here that a public change agency can and should be very important as resource linker, reinforcer, process helper and catalyst in the whole

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[6]Dietrich Stotz, op. cit., (1980), p. 148.
[7]Michael Collinson, "Research and Technology: Contribution from Social Sciences". (1980), pp 1-7.
[8] T. Alf Petersen, "Technology Transfer in Agriculture" A Paper Presented at the Region 1 Spring Meeting, Edmonton, Alberta Agriculture, June 1982.

process of adoption. Stotz has shown that government policies and activities can affect the adoption of innovation.[9] Feder has also demonstrated that policies such as subsidies on input and output prices, special credit facilities and communication media may influence the rate and speed of adoption of new technologies.[10] This author further argues that those policies which enhance adoption of one innovation may discourage adoption of the other, even when the two innovations seem to complement each other. Similarly, Sisler and Colman have considered the effects of government policies and institutional conditions in their analytical framework of technical change among the rural people of Asia.[11]

The receiver in the communication process has variables which tend to affect his innovation decision behaviour. As has been indicated earlier personal factors such as attitudes and habits can influence the adoption of an innovation. As Mosher has pointed out, farmers (receivers) should be considered as persons who vary geographically and culturally, who live by habits.[12] Second, they also farm for

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[9] D. Stotz, op. cit., (1980), pp. 147-160.
[10] Gershon Feder, "Adoption of Interrelated Agricultural Innovations: Complementarity and the Impacts of Risk, Scale and Credit". *American Journal Of Agricultural Economics* Vol. 64, No. 1 (Feb. 1982): pp. 94-101.
[11] Daniel G. Sisler and David R. Colman, "Poor Rural Households, Technical Change and Income Distribution in Developing Countries: Insights from Asia," *American Economics Review* 79-13 (New York: New York State College of Agriculture and Life Sciences, 1979), pp. 13-17.
[12] Arthur T. Mosher, *Getting Agriculture Moving: Essentials for Development and Modernization* (New York: Frederick A. Praeger Publishers, 1966), p. 15.

what they can get out of it, either in goods or in personal satisfaction. Third, they place high value on the good will and approval of their families and neighbours.

This third aspect relates to the role of the social system in the adoption process. Researchers have identified social system as important to receivers of innovations. Mosher has also indicated that there seems to be a shift of farmers' traditions and social values towards attaching higher value to individual experimentation and new methods where the new agricultural technology is favoured and people have begun to enjoy its benefits. The author has also noted that under primitive agriculture and fear of natural catastrophe, traditions are usually designed to protect the group against famine or other disaster rather than to encourage experimentation with new ideas and new techniques of production.

An analysis of the innovations in terms of the above mentioned variables will provide the extension or change agent with guide lines for the type of information and activity which needs to accompany the innovation, as the diffusion process unfolds. Thus, it can be concluded that the degree of success of adoption of a new technology depends upon adopter characteristics, perceived benefits of the innovation, diffusion methods, and the social system. In Chapters IV and V some of the concepts described in this chapter will be applied to the analysis of the diffusion activities and adoption of improved dairy cattle and the

management practices of these breeds, in southern Kakamega, Kenya.

III. THE AREA AND METHODOLOGY OF STUDY

A. Introduction

This chapter is divided into 2 parts. The first part includes a description of the location, demographic and physical featurers of the area studied. The second part of this chapter describes methods used in this study. This second part also outlines the methods of processing and analyzing the data collected.

B. The Area Studied

As shown in Figure III-1, Kenya consists of eight adminstrative provinces. Provinces consist of districts and these in turn are made up of locations, while locations are divided into sub-locations. Sub-locations are made up of villages, and villages are made up of households. A household is the unit of analysis in this study. Western Province has three districts: Kakamega, Busia and Bungoma. Kakamega district has 8 divisions. Three of these divisions (Hamis, Ikolomani and Vihiga) are studied.

The area studied covers the southern part of Kakamega district. The area is densely populated. The 1969 census showed that this area had a human population density of over 400 persons per square kilometre.[1] At an estimated annual

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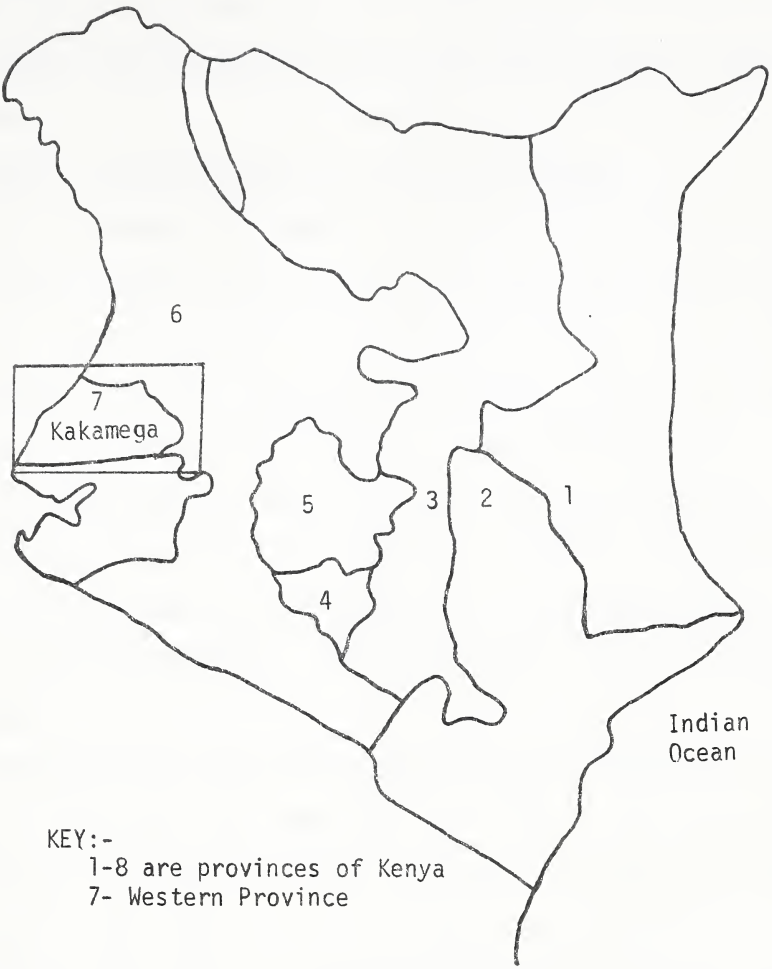
[1] J. Heyer, "Achievements, Problems and Prospects in the Agricultural Sector". In: Judith Heyer, J. K Maitha and W. M. Senga (eds.) *Agricultural Development in Kenya: An Economic Assessment* (Nairobi: Oxford University Press, 1976) p. 32.



Adapted from: J. Heyer, J. K. Maitha and W. M. Senga (Eds.), Agricultural Development in Kenya (Nairobi: Oxford University Press, 1976), p.186.

Notes: Western Province consists of Kakamega, Bungoma and Busia districts. Head offices of Western Province are located in Kakamega town.

Figure III.1 Map of Kenya Showing Location of Kakamega District

growth rate of 3.9 percent, the population density of this area is now estimated to be over 800 persons per square Kilometre.

The Physical Environment of the Area Studied

Southern KaKamega is a medium to high potential agricultural area. Major crops grown are maize, beans and bananas for food, and tea and coffee for cash generation. Livestock is an integral part of the farming system in the area. Types of livestock include cattle, goats, sheep and poultry.

The area has an annual average rainfall of over 1800 millimetres. The area studied has a bimodial rainfall pattern with long rains from March to June and short rains from August to November. The dry season is from Decemberto February.

Lihanda has reported the soils to be ferrosols to arisols.[2] He has also reported that these soils have fairly good physical properties but are poor in plant nutrients and need fertilizer application to sustain agricultural production. The lack of adequate plant nutients in these soils can be attributable to heavy use for agricultural production with limited fertilizer application.

This study area lies mostly on a margin of a peneplane, with slope classes of about 8 percent. The altitude of the area is about 1650 metres (5500 feet) above sea level.

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[2] F. C. L. M, Lihanda, "Adaptive Research Planning : A Case Study of Vihiga Division, KaKamega district" (Nairobi: CIMMYT Publications, 1978), pp. 5-8.

There are numerous permanent streams, these being the main headwaters of River Yala. Alluvial flats and marshes are of considerable size. Lihanda has also reported that little or no effort has been made to reclaim these valleys for farming, to provide an easy but limited source of fertile land.[3]

Farm inputs for crop and livestock production are stocked in stores situated in major shopping centres of Kakamega. Major cash crops are marketed through semi-Government marketing agencies. Milk is marketed mainly through informal channels (from one household to another). There are about five auction markets mainly for local cattle, in the whole area studied.

Southern Kakamega is well served by a road network which gives access to the main service centres like Majengo, Luanda, Hamis and Khayega.

C. Methodology

Introduction

The objectives of this study suggest an exploratory and descriptive research design. Exploratory research is concerned with discovering ideas and insights, establishing priorities, and generating information about practical possibilities of solving specific research problems. Detailed questionnaires or precise probability sampling are rarely used in exploratory research. Descriptive research is

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[3] F. C. L. M. Lihanda, op. cit., (1978), p. 5.

used for looking at the frequency of occurance or at the relationship between two variables.[4]

Because the information required to achieve the objective of this study is not completely available through secondary data sources, primary data must also be obtained. The survey approach was used to secure the needed data.

Data collection was carried out in two stages, presurvey and formal survey. This collection of data was done by the author and two assistants, all employees of the Ministry of Agriculture at Western Agricultural Research Station (WARS)in Kakamega. CIMMYT[5] economists in Nairobi supervized the data collection and gave necessary advice.

The Preliminary Survey (Presurvey)

A presurvey of farmers is an exploratory survey carried out first, to describe farmers' circumstances in order to illuminate the socio-economic conditions under which farmers operate, second, to describe how farmers in the area are operating; third, to relate farmers' circumstances to their farming methods, and to understand why they farm that way.[6]

A presurvey of Kakamega district was done during August and September of 1979 to identify general farming systems, practices and problems. On the basis of the presurvey

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[4] Gilbert A. Churchill, Jr. *Marketing Research, Methodological Foundations,* 2nd Edition (Hinsdale, Illinois: The Dryden Press, 1979) p. 49.

[5] CIMMYT stands for Centro International De Mejoramiento De Maiz Y Trigo (International Maize and Wheat Improvement Centre) of Mexico stationed in Nairobi to carry out adaptive agricultural research in Kenya.

[6] CIMMYT "Planning Technologies Appropriate to Farmers: Concepts and Procedures" (Londres: Mexico, 1976) p.11.

results (similarity in farming systems and problems), Kakamega district was divided into two areas, southern and northern Kakamega (see Figure III-2). Southern Kakamega is a more densely populated area than northern Kakamega.

A more detailed presurvey was done in southern Kakamega during January and February of 1980. The objectives of this presurvey were:-

1. To examine the feasibility of integrating improved dairying into the existing farming systems.
2. To formulate a dairy research programme to develop technologies appropriate to the circumstances of farmers in the area studied.

This study uses some of the presurvey information to establish hypotheses that are tested in chapter five. On the basis of the presurvey findings , a formal survey was planned and implemented in southern Kakamega.

The Formal Survey

After the presurvey, plans for the survey were made. These plans included sampling, and development and adminstration of the questionnaire.

Sampling

A list of farmers (or cattle farmers) was not readily available from any source. Thus a sample of farmers keeping cattle in this area was drawn from a list obtained from government administrative offices. The lists contained seven villages which were chosen from seven locations at random.

KEY:-
Locations surveyed
1- Idakho
2- Isukha
3- North Maragoli
4- West Bunyole
5- East Bunyole
6- Tiriki
7- South Maragoli

Divisions:-
Ikolomani (1,2)
Vihiga(3,4,5,7)
Hamis(6)

Adapted from: Survey of Kenya, Kakamega Branch.

Figure III.2 Map of Kakamega District Showing Study Area

See Figure III-2. [7]

A random sample of 8 farmers from each of the seven villages (56 farmers) was the unit of analysis selected. However, in every village the first six farmers were interviewed. When the one or two of the first six farmers were absent or responses were unsatisfactory, the 7th and 8th farmer was interviewed as a replacement.

After interviewing 42 farmers, it was found that only one of these farmers had improved cattle. Twelve farmers in southern Kakamega with improved dairy cattle were purposely selected from a list of 50 farmers with improved cattle from two locations of the area studied. After examining the 54 questionnaires, one questionnaire was discarded. This study is consequently based on 40 farmers with unimproved cattle and 13 farmers with improved cattle.

It is important to note that the sample of 13 farmers with improved breeds of dairy cattle, was a representative sample size for the proportion of farmers keeping the improved cattle in the area studied. Furthermore, the size of the two samples (53), was chosen to meet resource constraints of 3 enumerators, 1 vehicle and limited petrol.

The Questionnaire

The questionnaire which is presented in appendix III-1, consisted of 93 questions. It was developed by the author with the assistance of CIMMYT economists. It is to be noted

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[7]The number of sub-locations per location ranged from 6 to 9. The number of villages per sub-location ranged from about 10 to 15. Each village had from 40 to 100 households.

that this was a general questionnaire aimed at obtaining detailed information on improved dairy farming in southern Kakamega. The part of the questionnaire used for this study on improved dairy cattle is marked by asteriks.

The questionnaire was written in English but was administered in the language of the farmers (Luhya). The questionnaire contained mostly open-ended questions and a few close-ended questions. A large portion of the questionnaire contained "yes" and "no" answers. The tabulated questions required checking off the relevant answers.

The questionnaire was divided into five parts which are described below.

(1) General information

The first section was designed to gather some background information about the farmers' farming experience, training and available family labour. This general information also formed the social set up of the households studied.

(2) Land Use

The major distinguishing feature of this study area is limited land. Information about allocation of land to various farm enterprises was obtained from questions in this section to test the hypothesis "that lack of grazing land" was significant variable in adoption of improved cattle.

(3) Livestock Section

The part of the questionnaire concerned with livestock comprised over 50 percent of the questions. This part of the questionnaire was divided into several sections. Types of livestock kept by farmers in this area were determined. Then specific questions on dairy cattle were presented in the questionnaire. The purpose of keeping cattle and numbers of cattle kept per household formed another section.

(a) Breeding Management

Presurvey findings had shown that most farmers in this area used natural mating rather than artificial insemination. Reasons for this behaviour had to be obtained from the responses made.

(b) Pests, Diseases and Their Control

From the presurvey results and observation, ticks and worms were reported to be major parasites here. This section was concerned with the availability, efficiency and quality of the dips for the control of ticks. The "Dawa" section was designed to determine the possibility and frequency of deworming the cattle.

The disease control section was designed to collect information on the availability of

veterinary services and facilities.

(c) Feed Management

This section of the questionnaire was designed to collect information on the types of cattle feed and the months of their availability. Hypotheses related to this section were:(1)"that lack of grazing land" (2)"that lack of cash" and(3)"that lack of managerial skills".

There were also questions on water availability, housing cattle, and milking. Answers to these questions suggested the level of cattle management that was practised in southern Kakamega.

(4) Labour, Land and Cash Problems

This section of the questionnaire was intended to gather information on the respondent's problems related to labour, land and cash. Hypotheses related to these questions were: (1)"lack of grazing land" and "lack of cash ".

(5) General Questions at End

The final section of the questionnaire was concerned with information about food and milk surpluses and deficits. The period during this survey was a food shortage season. Thus, questions about the immediate problem would make the farmer feel that the interviewer was concerned about the

welfare of the respondent.

General questions about problems with managing the improved cattle were also included to wind up the discussion. Questions 91 and 92 were used to identify dairy farming technology that could be easily adopted by farmers in the study area.

The Questionnaire Administration

The author and two assistants administered the questionnaire to the farmers between June 3 and June 20, of 1980.[8] The two enumerators were familiar with the agricultural set up of the area surveyed. They were also familiar with the social and cultural background of the farmers in this area. They were proficient in the English and local languages, with research experience of over five years.

The two enumerators were trained by the author with the assistance of CIMMYT economists in the procedures of conducting formal interviews.[9] This training lasted three days. The training focused on the content of the questionnaire, discussing each question in detail. This training also included approaches to farmers during the interview and how to handle farmers who may not cooperate on certain questions. Details about terms used in the questionnaire and how to ask questions were also emphasized

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[8]The author and the two assistants were employees of the Ministry of Agriculture ,Repulic of Kenya attached to Western Agricultural Research Station, Kakamega.

[9]"An Example of An Enumerator's Reference Manual For Farm Surveys"in CIMMYT, *An Occasional Series of Paper Number 7* of February 1980,was used for this training.

during the training.

As part of the training, the questionnaire was pretested by three interviewers using three farmers from the study area.[10] This pretest also lasted three days. Following the pretest, some adjustments were made to the questionnaire. The final questionnaire used is presented in Appendix III-1.

The Interview

Personal interviews were conducted by the author and the two trained enumerators after informing the selected farmers and their chiefs. All the interviewers travelled in one vehicle to one selected village at a time to interview the selected farmers. On arrival in the selected village, enumerators were met by the chief of the area and the farmers. The farmers were introduced to the interviewers by the chief. Then each interviewer was assigned two farmers for the day.

An interview lasted two to three hours. At the end of the day, the completed questionnaires were checked for errors. Then all the completed questionnaires were collected and filed away.

The two enumerators were supervised by the author throughout the survey, who re-emphasized the difficult sections of the questionnaire. The supervision was necessary to ensure that the enumerators were actually interviewing the farmers, and that their relationship with the farmers was good.

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[10]The pretest is not included in the analysis.

On two occasions, two other agricultural research scientists from Kakamega research station (WARS), accompanied the interviewers to help with supervision of the interviews. This was done to give these researchers an insight into the problems farmers in Kakamega faced. On the same occasions, an economist with CIMMYT from Nairobi also accompanied the interview team and helped supervise the interviews.

A total of 54 farmers were interviewed. As said before, one questionnaire was discarded because the responses were inadequate. Apart from primary data, this study also uses data published mainly by the Kenyan Ministry of Agriculture.

D. Data Processing and Analysis

The data gathered are analyzed using the Statistical Package for the Social Sciences (SPSS).[11] The level of measurement for most of the data is nominal. Relative frequency (percent) and cross tabulations are used to indicate the association of the independent variable (improved dairy breeds) and the level of management of dairy cattle by farmers in this area. The Chi Square analysis is used to test the significance of differences in adoption levels of dairy breeds among the two groups of farmers.

Where the data is ordinal or interval, the median or mean is calculated and in certain cases the data is

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[11] Norman H. Nie et al., *Statistical Package for the Social Sciences.* 2nd Edition (New York: McGraw-Hill Book Company, 1975), pp. 239-241.

tabulated by absolute and relative frequencies. All hypotheses are tested at the 0.05 level of significance. The results of analysis of data are presented in Chapter V.

IV. DAIRY RESEARCH AND EXTENSION SERVICES IN KAKAMEGA

This chapter describes major recommendations made by the Ministry of Livestock Development to farmers concerning dairy farming practices in Kenya in general, and in Kakamega in particular. The chapter concludes with a description of the structure and role of extension staff in the development of dairying in Kakamega. The principal sources of data for this chapter are reports published by the Ministry of Livestock Development in Kenya and other institutions.[1] In the next chapter the socio-economic factors affecting the development of dairy farming in Southern Kakamega are examined using data from the sample survey described in Chapter III.

A. Recommended Practices of Dairy Farming in Kenya

As has been stated by Stotz (1979) research recommendations of improved dairy farming practices were developed for dairy production on large farms. The same recommendations were then utilized for management practices on small scale farms.[2] Recommended breeds of dairy cattle and their management are outlined in this section.

Dairy Breeds

While the native zebu cattle are found throughout Kenya, commercial dairy farming recommendations for small farms in Kenya are based on imported European breeds of cattle. These

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[1] The specific reports are cited in subsequent sections of this chapter.

[2] Dietrich Stotz, op. cit., (1979), p. 22.

breeds require a high level of feeding, disease control, and husbandry practices. Different breeds are recommended for different ecological zones of Kenya. Dairy breeds recommended for Kakamega which is an area of high rainfall are the temperate breeds, namely Friesian, Ayrshire, Guernsey and Jersey.[3]

These temperate breeds also are believed to have excellent fertility traits such as regular calving intervals and good mothering abilities. They have higher milk yield but lower butter-fat content than the indigenous Zebu cows. Further, these improved cattle are generally larger in body weight than the small East African Zebu. However, the improved dairy cattle are susceptible to most tropical diseases such as tick-borne diseases and tripanosomiasis. These breeds from Europe have been well adapted to the cool, wet highlands of Kenya and are being made adaptable for adoption in the hot , humid lowlands of Kakamega. A general recommendation concerning these improved dairy herds is that the animals should be well fed and should receive good management. Musangi has outlined the things to be done before the veterinary department can give permission to introduce the improved breeds:-

1. The grazing land must be fenced if animals are fed outdoors.
2. The fenced land should be grazed by the Zebu cattle that

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[3] *Annual Report* 1979, (Naivasha: National Animal Husbandry Research Station).

have been thoroughly dipped into or sprayed with an effective acaracide.

3. The land should be free of bush and unpalatable grass species.
4. Clean drinking water should be provided on the farm, preferably in the grazing area.

[4]

On the other hand, the Zebu cows have excellent mothering ability, fair fertility rates, giving relatively low yields of milk, but they are relatively resistant to tick-borne diseases. It is noted that most of the recommendations apply to Kenya in general and are not specific to Kakamega.

Feed Management

In general, it is recommended that farmers keep their cows on grass as long as possible since purchased supplementary feeds are considerably more expensive and mixing feeds at home is difficult. It follows that good management of pastures and fodder as well as preserving hay or silage are important to supply the needs of the cow. In general, the amount of concentrates to feed a cow depends on the quality of the grass. Though the carrying capacity of pasture for dairy cows can vary considerably, it is recommended that the carrying capacity is two acres per cow. Thus, substantial

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[4]op. cit., (1977), pp.7-9.

area of land is required, unless zero grazing[5] is adopted. Zero grazing is a new system of intesive dairy farming in most parts of Kenya, particularly in Kakamega. Successful results of this system have been achieved on other small scale farms such as Kiambu, Nyeri and Kisii.

The most commonly used pasture species are Rhodes Grass (*Chloris gayana*, Nandi Seteria (*Seteria sphacelata)* for the purpose of pasture seed production carried out by the Kenya Seed Company. As Musangi has indicated, it is recommended that the nutritive status of pastures, legumes must be included.[6] He has also shown that *Desmodium intotum, Desmodium uncinatum* and *Centrocema pubescens* are good for humid areas, while *Stylosanses gracilis* is recommended in the drier areas, and *Trifolium repens* (Kenya white clover) in the highlands.

Rotational grazing is another recommended system of managing pastures in Kenya as a whole. Rotational grazing consists of grazing animals in one paddock for a period and then transferring them to a fresh paddock. However, grazing pressure of cows on small farms limits the possibility of rotational grazing in Kakamega. Further, it is recommended that these pastures be improved by application of fertilizers, mainly nitrogenous fertilizers. This is because of the high rainfall in the high potential areas of Kenya,

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[5] Zero-grazing involves bringing cut herbage and feeding to the animal in a stall. The forage types used in zero-grazing can be purchased from other farms or grown on the farms.

[6] R. S. Musangi, *Dairy Husbandry in Eastern Africa* (Nairobi: Longman Press, 1977), pp. 7-9, 85, 93 and 110.

like Kakamega that causes much of the soil nitrogen to be leached to the lower layers of the soil where it is not available for plant growth.

Disease Control

Disease control is another aspect of management that dairymen are asked to participate in. The most important factor in the elimination of diseases is prevention. Many diseases can be prevented by applying good sanitary methods, proper feeding and timely vaccinations and isolations. Tick-borne diseases are quite common in Kakamega. Dipping or spraying is the recommended method of control of ticks in this area.

From the above description, it is evident that improved breeds of dairy cattle require higher levels of feed and disease management than the native cattle. However, recommendations for crosses between the European breeds and the native Zebu types have not been established.

B. Extension Services and Dairy Farming in Kakamega district

In this section the structure of the extension services in Kenya and in Kakamega district is outlined. Also, the role of extension workers in dairy development is described, indicating some of the main problems facing farmers in Kakamega district.

Structure of The Extension Services

The Ministry of Livestock Development in Kenya is responsible for the development and production of all

livestock (cattle, poultry, pigs, sheep, goats, fish and bees) in Kenya.[7] This Ministry consists of departments of Veterinary Services and Animal Production. In this study the structure of the extension services of the department of Animal Production which provides most of the livestock services in the ministry of Livestock Development is described.

The structure of the extension services in Kakamega district is worthy of mention here. In 1979, there was one District Animal Production Officer (DAPO) and one District Veterinary Officer (DVO) in Kakamega district. Each of these officers usually hold university degrees either in agriculture or veterinary medicine. In the same year there were eight Technical Officers (with diplomas in agriculture), each responsible for a division. Also, there were sixteen technical assistants (with certificates in agriculture), each responsible for a location. At farm level there are Junior Agricultural Assistants responsible for four to five villages who provide advice to livestock farmers.

In addition to the animal extension services provided through the structure described above, information from the Annual Reports of the Department of Animal Production show that there have been a number of special programmes or projects concerned with livestock production in Kakamega

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[7]The Ministry of Agriculture is responsible for the development and production of crops.

district. One example of these projects was the extension services provided by the Danish Government to improve dips in Kakamega district. Another example is the National Dairy Development Project.[8] This is a smallholder extension service programme which is executed jointly by Kenyan and Dutch Governments. This programme aims to improve pasture and the feed management of dairy cattle. A third is the International Agricultural Development Programme which supports dairy development through strengthening and facilitating general extension services.

The Role of Extension Services in Dairy Development

Stotz (1979) has reviewed the historical development of the animal extension workers in the development of smallholder improved dairy farming.[9] In this section, the role of animal extension workers in Kakamega district is described for the period from 1970 to 1979. The sources of information for this part of the study are Annual Reports of the Department of Animal Production.

Information from Annual Reports (1970 to 1979) shows that, animal extension workers in Kakamega district have been responsible for advising farmers on three broad aspects of dairy management: improvement of pastures and dairy herds, and control of diseases. The improvement of pasture in Kakamega district has been the main focus of extension

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[8] Kenya, Ministry of Livestock Development, Animal Production, *Annual Report 1980,* (Nairobi: 1980),pp. 12, and 23-43.

[9] D. Stotz, op. cit., 1979, pp. 14-16.

workers in Kakamega. Information from Annual Reports (1970 to 1979) shows that attempts have been made to introduce improved pasture such as Rhodes grass and napier grass. In addition, there have been some efforts to clear bushes, may be for livestock land use. As shown in Table IV-1, the total area planted with improved pasture and fodder and cleared bush has fluctuated from year to year, though it seems that there has been a slow growth in the total area of improved pasture and fodder. The area of cleared bush does not indicate whether this area was for livestock or was for other land uses. The Annual Reports do not indicate any reasons for the slow growth in the area under improved pastures.

A second service provided by extension workers has been concerned with the improvement of the herd in the district. Information from Annual Reports shows that this has been undertaken following two approaches. One approach has been the importation of improved breeds of dairy cattle (Jerseys, Guernseys, Friesians and Ayrshires) into Kakamega. A second approach has been through artificial insemination (AI) programme. The reports suggest that imports of improved dairy breeds into Kakamega grew in the mid 1960s, when credit was available to farmers for the purchase of these breeds and extension services were adequate. Apparently, therefore the number of farmers purchasing improved cattle expanded, and the supervisory capacity of the extension workers seem not to have been adequate. Further, the

TABLE IV-1

Area of Improved Pasture and Cleared Bush in Kakamega 1970-1979

Year	Area of improved ley	Area of improved fodder	cleared bush
	Hectares		
1970	36	46	604
1971	139	104	746
1972	164	106	1389
1973	62	81	
1974	110		
1975	155	350	170
1976	121	194	1046
1977		544	
	107		239
1978	140	592	693
	(746)	(960)	
1979	152		134

Source: Kenya, Ministry of Livestock Development, *Annual reports* (various issues 1970 to 1979).

Note: The figures in paranthesis refer to total area under fodder or ley.

extensive heat in the lowlands coupled with many disease problems seem to have discouraged direct import of improved dairy breeds. It is also reported that the cost of dairy breeds has tended to be substantially higher than the maximum credit that the Agricultural Finance Corporation (A. F. C.) provided for the purchase of these dairy breeds.[10] Thus, it appears imports of improved dairy breeds into Kakamega has been on the decline.

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[10] Kenya, Ministry of Livestock Development, Animal Production, Kakamega District, *Annual Reports 1977* (Kakamega: 1977), p. 27.

The Artificial Insemination Programme involves inseminating improved and local Zebu cows with semen of improved bulls. This programme requires that farmers castrate their bulls (zebu and improved). Also, the farmers have to bring cows on heat by the road-side for insemination. For some farmers this has meant travelling for long distances to find an inseminator. The perceived benefits to farmers opting for AI have included increased milk production and some resistance to diseases and heat. Even then it appears that the number of AI remained constant from 1974 to 1976.[11] It was reported that in 1977 and 1978 the number of AI declined slightly, though in 1979 it was reported that this had increased.

A third important focus of the extension workers in Kakamega has been the control of cattle diseases. Information from the Annual Reports (1970 to 1979) shows that the main diseases are the tick-borne diseases, foot and mouth disease, anthrax and rinderpest. Most of these diseases have been reported to be fatal to improved breeds of dairy cattle. It is stated in Annual Reports that the success on the control of tick-borne diseases has been limited. Information from these reports indicates that in some cases, farmers do not dip as frequently as they should, while in other cases the management of dips has been poor. Consequently, tick-borne diseases have been one of the main

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[11]Kenya, Ministry of Livestock Development, Animal Production, *Annual Reports 1976,* (Nairobi: 1976), pp.25-29.

problems facing improved dairy cattle farmers in Kakamega district. Other diseases such as rinderpest, anthrax, and foot and mouth seem to be effectively controlled whenever vaccination is implemented early.

Other extension services provided to farmers have included education at the Farmers' Training Centres[12] and on field days and farm visits. It is evident that extension workers have encouraged improved dairy farming in Kakamega. However, it appears that the progress has not been satisfactory.

It can be concluded that the recommended dairy husbandry practices are backed up by research which is conducted in a foreign place. Thus, the research is not specific to Kakamega district as a whole, and particularly to southern Kakamega. Further, results of dairy research are not well diseminated to farmers of the area studied, partly because of the farmer's attitude and mostly due to limited quantity of qualified staff. In the next chapter the socio-economic factors hindering the development of dairy farming in southern Kakamega are examined using data from the survey of fifty three farmers.

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[12]Farmers' Training Centres are Ministry of Agriculture centres for training farmers in different production practices. These courses last for one or two weeks.

V. ANALYSES AND RESULTS

Data from the oral questionnaire survey discussed in Chapter III are used to assess the socio-economic and technical factors influencing the adoption of improved dairy cattle breeds in Southern Kakamega, Kenya. As also indicated in Chapter III, frequency distribution and Chi-square test are used to test the hypotheses set out in Chapter I. In some cases averages are used to verify these hypotheses.

As outlined in Chapter IV, the sample consisted of forty farmers with unimproved cattle breeds and thirteen farmers with improved dairy cattle breeds. The forty farmers represent non-adopters while the thirteen farmers represent adopters of improved cattle. The objective of this chapter is to compare dairy farming systems of these two groups of farmers and to identify socio-economic and technical factors that may be influencing the adoption of dairy breeds in Southern Kakamega.

A. Socio-economic Characteristics of Farmers in Southern Kakamega

Farmers who were interviewed were mainly men, since they made major decisions in farm operations. They all spoke one language, Luhya. About all the farmers interviewed (92.5%) had operated their farms for more than eleven years. All the respondents owned farms on which they lived. The farm size ranged from 0.75 to 14.25 acres per adopter, and from 1.25 to 16 acres per non-adopter. The mode of the land size was

TABLE V-1

Total Area of Land on Sample Farms

		No. of Farmers with				
		0-.99	1-2.99	3-4.99	5-9.99	10+
			Acres			
Adopter:	No.	0	1	2	5	5
	%	0	7.7	15.4	38.5	38.5
Non-adopter:	No.	3	12	16	6	3
	%	7.5	30.0	40.0	15.0	7.5
Total:	No.	3	13	18	11	8
	%	5.7	24.5	34	20.8	15.1

Chi-square= 13.54906 with 4 degrees of freedom.
Significance=0.0089

between 2 and 3 acres for non-adopters and between 5 and 10 acres for adopters. Results from Table V-1 also show that about 77 per cent of non-adopters owned land size below 5 acres. The results show that two farmers out of thirteen farmers owned land size below 5 acres. There were 5 farmers out of 13 adopters owning over 10 acres of land.

The education level of the farmers keeping improved cattle tended to be higher than that of the farmers with local cattle. Most of these thirteen farmers with improved dairy cattle had off-farm jobs, mainly as teachers that required literate and trained personnel. Three of the thirteen adopters had been able to attend short courses at a

Farmers Training Centre (FTC). Five out of forty non-adopters had also attended some courses at the FTC. Of these five farmers, only one had attended courses in dairy management. The other four farmers attended courses in general agriculture, mainly crop production. In general, both groups of farmers had some elementary education but the level of education varied between them.

The results show that about 38 % of non-adopters and about 77% of the adopters had jobs off the farm. On the average, forty per cent of the labour used on farms with improved cattle and sixty five percent of the available labour on farms with local cattle was family labour. Seventy seven per cent of adopters of improved cattle had between 2 and 6 members of the family of working age. It is worth noting that there was hiring of labour during the long rains (65% for non-adopters and 69% for adopters) mostly for land preparation and weeding of maize and beans.

The size of the household of the fifty three farmers ranged from two to twenty three with an average of eight members per house hold. This included relatives and the unmarried children of these farmers. This excluded any relatives or children that lived away during the time of the survey. The adopters had an average of ten persons per household, while the non-adopters had an average of eight persons per household .

Table V-2 shows the sources of cash for adopters and non-adopters. The main source of cash for adopters was

TABLE V-2

Sources of Cash for Sample Farmers

		No. of farmers with source of income from					
		Sell cattle	Sell crop	Sell milk	Off-farm	Relative	No source
Adopters:	No.	4	1	1	6	1	0
	%	30.8	7.7	7.7	46.2	7.7	0
Non-adopters:	No.	7	11	3	11	4	3
	%	17.9	28.2	7.7	28.2	10.3	7.7
Total:	No.	11	12	4	17	5	3
	%	21.2	23.1	7.7	32.7	9.6	5.8

Chi-square = 4.56280 with 5 degrees of freedom.
Significance =0.4715

off-farm employment, while for non-adopters, the main sources were sales of surplus maize and beans; and members of the family and relatives who had off-farm employment. Other sources of cash for both groups of farmers were sales of cattle, milk and some crop products (coffee and tea). The Chi-square test indicates that there was no significant difference in the sources of cash between adopters and non-adopters of improved dairy cattle. However, forty six per cent of adopters relied on off-farm employment that was permanent while 28% of the non-adopters had off-farm jobs that were casual.

Mixed farming was prevalent pattern with food crops and local cattle as the major enterprise mix. Maize and beans

formed the commonest inter crops as well as staple foods of the area. Other food crops were bananas, millet, sorgum, cowpeas and groundnuts. Coffee, pawpaw, sugarcane and tea were common cash crops on farms with improved cattle. Other livestock kept on these farms were local poultry and sheep, with limited numbers of pigs and goats.

Most of the respondents owned all the cattle that they kept on their farm. Twelve out of thirteen adopters owned all the cattle on the farm. One farmer out of thirteen farmers kept a heifer for his brother. Four out of these thirteen farmers kept some local cattle away from their homes. Out of the 39 non-adopters who answered the question on ownership of cattle, 26 of these owned all the cattle, while 6 out of 39 owned some and kept some away. Seven out of these 39 farmers either owned or only kept cattle for friends and relatives. The main reason for this practice of keeping cattle away from own home was because of lack of sufficient grazing land within the study area. Nine out of thirteen adopters of improved dairy cattle owned both improved and local cattle but the propotion of the local cattle was less than that of the improved cattle. Further assessment of cattle population is presented in the dairy farming section of this chapter.

Discussion

The socio-economic characteristics of the farmers surveyed agree with the circumstances of these farmers as indicated by Lihanda, 1978. That is, large family size, small land

acreage, the search for off-farm employment, and limited formal and informal education. The review of special rural development programme in this area showed that some of the socio-economic problems of the people included high population (1500 persons per square mile), and outmigration into towns.[1]

It is noted that about 38% of the adopters had formal post-elementary school education and were employed as teachers and civil servants. On the contrary, the off-farm jobs that were taken by non-adopters required little or no formal training.

Although, farmers keeping local cattle ranked sales of food maize and beans as the major source of cash, sale of cattle seemed to be a more reliable source of savings, since revenue from cattle sales was used for settlement of school fees and dowry expenses. Also, there was no indication that credit was given to the farmers with local cattle. Further, farmers with improved cattle were not willing to discuss matters related to loans. Thus, it was not easy to assess the extent to which credit was used on these farms.

It can be concluded that adopters of improved dairy cattle were innovators, while the non-adopters of these cattle were late majority and laggards. Thus, the adopters had more resources than the non-adopters of these breeds of dairy cattle.

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[1]Kenya, "Special Rural Development Programme, Review/Replan: 1973./76," p. 2.

B. Dairy Farming System in Southern Kakamega

In this section the state of dairy farming in southern Kakamega is presented. The features assessed include the composition of breeds (improved and local) and breeding, feed management, disease control and housing. The state of dairy farming is discussed in the context of the available extension services outlined in chapter four. The state of dairy farming is then compared to the recommendations from research stations as outlined in Chapter IV.

Cattle Breeds and Breeding on Sample Farms

The main types of dairy cattle here were local (zebu). The survey results show that about 97 per cent of the total cattle population were local and the balance of about 3 per cent of the total cattle were improved. This is based on the fact that only one out of forty farmers from the random sample had improved cattle. These results agree with the data from the presurvey and from the Ministry of Agriculture which showed that less than five per cent of the total cattle population in this area between 1977 and 1978 were improved breeds. [2]

Improved breeds kept in southern Kakamega are mainly Friesian, Guernsey, Jersey and Aryshire. Twelve of the thirteen adopters of improved breeds kept only a single recommended breed (Friesian, Guernsey, Jersey or Aryshire). Ten of the thirteen farmers who had improved breeds also

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[2]Kenya, Annual Reports of District Animal Husbandry Office , 1977 and 1978 for Kakamega District.

kept local cattle on their farms. This indicates that adopters of improved dairy cattle do not give up keeping local cattle. Nine out of thirteen farmers had over 50 per cent of their herd composed of improved dairy stock. Sixty one (71%) of the total 86 cattle kept by adopters were improved while twenty five (29%) were local cattle. That is, the number of improved cattle dominated the number of local breeds on these farms.

The results in Table V-3 indicate that 70% and 31% of non-adopters and adopters respectively owned less than 4 head of cattle. Sixty two per cent of farmers with improved cattle had more than 6 head while only 10 per cent of non-adopters of improved cattle had more than six head of cattle. That is, on the average, the adopters of improved breeds tended to have larger herds than those who had not adopted improved breeds. The mean number of improved cattle per farm on the thirteen farms was 4.7, and 3.9 local cattle on farms not adopting improved dairy cattle. Chi-square test of value 15.22568, significant at 0.0005 level indicates statistically significant difference in herd size between non-adopters and adopters of improved cattle. The null hypothesis of "lack of grazing land" as a determinant of adoption of improved dairy cattle was tested and accepted. Thus, adopters had more land and more head of cattle than the non-adopters of the innovation.

TABLE V-3
Number of Total Cattle on Sample Farms

		No. of farmers with cattle		
		up to 4	4-6	6+
Adopters:	No.	2	3	8
	%	15.4	23.1	61.5
Non-adopters:	No.	21	15	4
	%	52.5	37.5	10
Total:	No.	23	18	12
	%	43.4	34.0	22.6

Chi-square = 15.22568. With two degrees of freedom.
Significance=0.0005

Discussion

The main improved breeds kept by farmers in this area are consistent with recorded breeds within Kakamega district. These are also the breeds recommended by the Ministry of Agriculture. As outlined in Chapter IV, most of these breeds are imported into Kakamega from large farms. The Ministry of Agriculture annual report for Western Province, 1979, showed the major sources of these breeds were: (i) Agricultural Development Corporation (30%), (ii) Private farms (50%), (iii)Up-grading by AI (15%) and (iv) Government farms (5%).

All farmers keeping any local cattle (adopters and non-adopters) were asked why they had local cattle rather than improved cattle. A number of reasons were given for keeping local cattle. One of the main reasons was that local

cattle were easily compatible with ecological conditions as well as with the resources available on these farms. The Zebus were resitant to diseases, heat stress and required limited feed compared to improved breeds. A related reason was that local cattle were easy to manage (disease control, milking, feeding, housing) compared to improved breeds. That is, improved cattle required more complex management than the farmers could afford, given the resources availablle. Another reason for keeping local cattle was that local cattle did not require hired labour for feeding and milking and did not require purchased feeds. Another reason given by the farmers was that the market for the sale or purchase of local cattle (calves, heifers and culls) was readily available within the area while that of the improved breeds was limited. A further reason for keeping local cattle was that these types of cattle were easily accepted for social obligations (dowry, funeral feasts) than improved breeds.

When adopters of improved breeds were asked why they kept these breeds, they stated that high milk production was the main reason. The results show an average milk yield of 1.5 kg for the local cow and 4 kg for the improved cow per day. Local chiefs also told us that keeping improved cattle was a symbol of status in this community.

Six of forty farmers not keeping improved cattle had done so in the past but had discontinued. The stated reason for discontinuing the keeping of improved cattle was that the costs, in terms of time, energy and funds, of managing

(feeding, housing, watering, controlling diseases) improved cows were considerably more than the benefits. Two of these forty non-adopters stated that they preferred improved cattle to local cattle and were considering the purchase of improved cows. Ten of the thirteen adopters preferred improved breeds of cattle, though they were concerned about the relative lack of disease resistance in these breeds. In addition, these ten adopters observed that the improved breeds required high levels of management practices than local cattle. These farmers observed that few farmers may have the resources and managerial skills required to keep improved cows.

As discussed in Chapter IV, the Ministry of Agriculture in Kenya has had an artificial insemination programme in southern Kakamega for about fifteen years. However, the use of artificial insemination has not been accepted to any large extent. Twelve of the farmers with improved breeds of cattle used artificial insemination while one farmer had his own bull. Eight percent of the farmers not adopting improved breeds reported that they had tried artificial insemination at one time. Sixty seven per cent of farmers keeping local cattle stated that they had not used artificial insemination because of a number of problems associated with this programme. One of these was that AI crushes were located far from where cows were to be confined while waiting for an inseminator were located far from most farms, as iseminators did not travel to individual farms. Another reason was that

calves from AI tended to be big for the local cows and therefore presented problems during calving. In addition, offsprings of the crosses were not as resistant to disease compared to local calves. Thirty seven out of the forty non-adopters used local bulls on their cows, and three of these farmers did not know about AI. The results outlined above concerning the AI programme agree with the findings of Stotz (1980) regarding AI in Kenya in general.

It seems that farmers in this area (adopters and non-adopers) perceived that the costs of keeping improved cows did not seem to justify the perceived benefits, considering the the complexity of management and limited resource base (land, capital and labour). It appears that an appropriate breed for this area has to be developed if dairy farming sector has to be improved. In the next section, the management of dairy breeds and control of diseases is presented.

C. Management of Dairy Cattle in Southern Kakamega

In Chapter IV, the recommended dairy management practices of the calf, heifer and lactating cow were outlined. In this section, the management of dairy cattle (improved and local) in southern Kakamega is presented. The main features assessed here are feeding, watering, housing and disease control practices.

Calf Management

As noted earlier in Chapter IV, the rearing of a calf starts with good management of the gestating cow. The results of this study show that local pregnant cows did not receive extra feed, except for accasional feeds of salt with maize stalks or in drinking water.

All local calves were suckled before and after milking the cows. In most cases the improved calves were fed milk from a bucket. This is the practice recommended by the Ministry of Agriculture. The amount of milk given to the calf was not quantifiable, particularly for the non-adopters. In general, it seems that local calves received the minimum amount of feed, since it suckled after the milking and it had no supplementary feeding.

The quantity of milk fed to improved calves at different ages varied considerably from one farmer to another.[3] The production of milk by improved cows in this area was not sufficient for selling and feeding the calf the recommended amounts. Farmers preferred to feed less quantities of milk per day than is recommended but over a longer period. In addition, these improved calves were grazed. Even then, the feed provided to the calves were much lower than those recommended by the Ministry of Agriculture. None of the farmers (adopters and non-adopters) fed concentrates to calves. Water was usually carried to the

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[3]On average, 1.8 kg , 1.1 kg and 0.35 kg of milk was given to each improved calf at four, twelve and twenty four weeks of age, respectively.

calves from the river. The amount of water fed to a calf averaged 3 litres per day. Again, this was inadequate water for the calves. Research recommends that water be given ad libitum to all dairy stock. In summary, it is evident from these survey results that the feeding of the calf is below the recommended requirements. It can be expected that the perfomance of calves would be lower than expected.

Sources and Availability of Feed

Results show that the most important source of feed for both local and improved cattle was grass. Farmers with local cattle grazed their cows on their homesteads, public land (school campuses and roadsides). The grazing was usually supplemented with green and dry maize stalks, sugarcane tops and banana leaves. Green maize stalks were the most preferred feed, in addition to grass. Additional feeds to improved cattle included minerals, wheat bran and fodder (napier grass). Also, common salt was added to drinking water or fodder. Unlike the non-adopters, most adopters of improved cows allocated part of their land to fodder crops such as local and improved napier grass, and natural grass. Two of the thirteen adopting farmers, planted improved pasture (Rhodes grass and Nandi Setaria). In addition to feed grown on their own farms, most farmers cut grass from river valleys, farms of friends or purchased grass from neighbours to feed the calves and the cows during the dry season (December to February). This was mainly because there was not enough grass available to the cattle. Though grazing

was done all year round, the results show that there was not enough grass all year round. It can be concluded that the standard of feeding cattle in this area was considerably lower than that recommended by research stations. In view of the limited pasture available on most farms in this area, it is evident that purchased feeds should be available to supplement farm feeds.

Improved cows may have suffered more from the shortage of feed during the dry season than local cattle which can survive on limited feed intake. It is likely that the shortage of adequate feed affected adversely the general performance of improved cows which are highly responsive to the quality and quantity of feed intake.

Watering

The watering of cattle is an important part of the feeding regime. Water supply to animals in this area was mainly from the river and catchment from house roofs. In general, all adopters of improved cattle carried water in containers to improved cattle, while all farmers drove local cattle to the river. In the dry season, the cattle required a lot of water per day but it was not available in rain fed tanks on these farms at that time. Three out of 40 farmers with local cattle watered their cattle on the farm throughout the year. From December to February over 61% of the farmers with improved cattle carried water from the river, while 38.5% had water from rain tanks. During the wet season (May to August) there was sufficient water in these tanks for both

household and animal use. However, in the dry season, the water had to be collected from the river. Only two out of the thirteen adopters of improved dairy cattle provided water to their cattle ad libitum. Again, it seems that most farmers (adopters and non-adopters) did not supply adequate water to the animals, especially during the dry season. It is likely that improving water supply to these farms may be an important prerequisite for increasing the performance of cattle on these farms.

D. Disease, Pests and Their Control

One aspect of importance to the management of dairy cattle, especially improved cattle is the control of diseases. The main disease reported by all farmers is East Coast Fever (ECF), a tick-borne disease. Though the local cattle were more resistant to this disease than improved stock, the disease caused some deaths of local cattle. This tick-borne disease was reported to be the main killer of improved cattle in this area and in Kenya, in general.

The composition of cattle which had died on the farms surveyed in the past eighteen months (between December 1978 and June 1980) prior to the survey are summarized in Table V-4. Nine out of thirteen farmers with improved cattle reported cattle deaths within 18 months prior to the survey. About 50 per cent of the farmers with local cattle reported deaths of cattle during the 18 months. Most of these deaths involved both local and improved calves.

TABLE V-4

Number of Cattle Deaths in the Past Eighteen Months

		No. of Famers reporting deaths			
		0	1-2	3-4	4+
Adopters:	No.	2	6	4	1
	%	15	46	31	8
Non-Adopters:	No.	20	14	4	2
	%	50	35	10	5
Total:	No.	22	20	8	3
	%	41	38	15	6

Chi-square= 6.08512
Significance=0.1075

The hypothesis that there is no significant difference in the number of improved and local cattle deaths was tested using Chi-square on the data in Table V-4. The test shows that there was no significant difference at the 10% level, between the number of improved and local cattle deaths over the 18 months. Even though there was no significant difference, it is worthy noting that 10 out of the 13 adopters reported at least some death compared to 20 out of the forty non-adopters experiencing cattle deaths.

Tick Control and Deworming

Methods of controlling ticks and worms were examined and the results are presented in Table V-5. In general, non-adopters either hand-picked ticks from the cattle or dipped the

TABLE V-5

Methods of Controlling Ticks in Southern Kakamega

		No. of Farmers Using				
		Hand pick	Dips	spray	Dip and spray	Dip and hand-pick
adopters:	No.	0	2	9	2	0
	%	0	15	69	15	0
Non-Adopters:	No.	14	22	2	0	2
	%	35	55	5	0	5
Total:	No.	14	24	11	2	2
	%	27	45	21	3.5	3.5

Chi-square= 34.2569 With four degrees of freedom.
Significance= 0.0000

cattle, while most of the adopters had sprayed the animals. These results imply that the proper management of dips in this area is important, as a means for controlling ticks. Adopters of improved cattle reported that they did not use dips, mainly because they were not well managed. They also observed that purchasing a sprayer was costly and they would have preferred to use dips if the management was good. These reports suggest that there is a need to restore some public confidence in the effectiveness of dips. A Chi-square test showed that there was significant differences in the methods of controlling ticks by adopters and non-adopters. It is worth to note that a large percentage of non-adopters (35%)

hand-pick ticks, a very ineffective method for controlling ticks.

Farmers reported that they had a number of problems with dipping. One major problem was the lack of sufficient dips in the area. Another reason was the inefficiency in operating dips, mainly the understrength of acaricides. Also, water for dip was scarce during the dry season and dips got muddy in the wet season. Due to these problems, farmers with improved cattle preferred to spray cattle either using their own sprayers (54%) or borrowing from friends (15%). However, a few farmers with local cattle owned spray pumps and 5 per cent borrowed spray pumps from friends. Most farmers dipped or handsprayed cattle against ticks at least once a week. About 17.5 per cent of farmers with the improved cattle sprayed once a week during the dry season and twice a week during the wet season.

The survey results show that none of the farmers keeping local cattle practised deworming. However, a number of farmers with improved cattle dewormed their cattle once a year and a few twice a year. Most farmers indicated that they usually requested for a Ministry of agriculture veterinary officer to treat their cattle. However, the farmers stated that not all the cases were attended to in time or satisfactorily, and either farmers had to purchase the drug from the store or use herbs to treat the animals.

Housing

Sixty per cent of the farmers surveyed kept their cattle inside the family house at night mainly because stealing of cattle in this area was acute. It seems that the problem of stealing cattle and limited space for housing the cattle at night limited the number of animals a farmer could keep without incurring extra costs of a watchman. Though a milking parlour is recommended, most farmers (69%0 milked the open. In general, housing conditions were satisfactory, especially for calves. Most farmers used droppings from these houses as manure for their crops.

It can be concluded that improved cattle require substantial facilitative and supporting services to survive in the humid areas such as southern Kakamega. Moreover, the Zebu dairy cattle are more adaptable to the conditions in this area.

Dairy Management Issues in Southern Kakamega

Land

The results discussed earlier strongly suggest that the resource base for dairying is small. Land was most limiting for farmers in the area studied. Besides, food and cash crops had priority for land use over dairy cattle. As was shown earlier, farmers keeping local cattle generally hasd an average of 0.25 acres, with a mode of between 0.5 and 1.5 acres of grazing land (homesteads). Adopters of improved cattle had an average of 2 acres of grazing land (homestead grass) plus extra land planted with napier grass. Due to the

small size of land, most farmers kept local cattle which could survive on limited grazing land of about 0.25 acres. It is evident from the survey results that a reasonable land size for crops and pasture was a prerequisite for keeping mproved cattle.

Permanent crops generated cash and this supported other farm operations including purchase of feeds. The results of the survey show that coffee and tea were cash crops for most farmers, followed by sugarcane, which was a new cash crop in the area (10% farmers growing). The results also show that farmers with improved cattle had more cash crops than those keeping local cattle. Again the land basis appears to be the main factor here. These adopters gave priority to tea as a cash crop. Thus, there was competition for land away from cattle.

Napier grass was grown to supplement unimproved pasture. Most farmers with improved cattle (61%) planted some napier grass. Over 56 percent of all the farmers indicated the need for grazing during the short rains (July to October) denied farmers the use of this land for crops. Since food crops were so important, farmers preferred to have local cattle which could survive on limited grazing land during the short rains. Farmers were asked how they would allocate any extra land if it was provided to them. All non-adopters of improved cattle stated that the first priority would be given to food crops, and second cash crops. Allocation of land for cattle use was not a priority

in the allcation of any additional land. This result indicates that the use of land for dairying is not a priority in this area.

Labour

Although, there was a large supply of family labour force, it was hardly sufficient during the peak periods. As shown earlier in this chapter, farmers keeping improved cattle used some hired labour more than the non-adopters. The busiest period for the adopters and non-adopters of improved cattle was from January to April. This is the time for preparing land for planting maize and beans (food crops), and weeding of these crops. The next busiest period was between July and August when farmers harvested the first (long rains, March to June) crops and planted and weeded the second (short rains) crops of maize and beans. It is worth of note that adopters of improved cattle needed permanent hired labour for grazing, milking and guarding cattle at night. Thus improved cattle placed a major demand on the resource on the farm.

Capital

Capital requirement for managing improved cattle in the area studied was substantial. Information from the local chiefs and Agricultural Development Corporation (AFC) indicated that a farmer changing from local to improved cattle needed to invest Kshs 1200 per dairy cow in such facilities as fences, watering, drugs, dipping or spraying, paying a herdsman, a crush and a milking shed. In addition, a dairy

cow cost about Kshs 3000. Lihanda (1978), has shown that farmers in this area had a net income of about Kshs 1200 per annum from the sale of farm produce. Thus, adopters of improved cattle must require off-farm cash to purchase feeds, land outside their homes, replacement cattle, hire labour and meet their own family needs. Further, Stotz (1980), has indicated that loan policy in Kenya, has tended to be stringent and that only farmers with good prospects for repayment can usually invest in a dairy cow using credit that would be available. Even then, as shown earlier, the credit provided by AFC to buy dairy cattle is not enough to buy one animal. The farmer must provide half the cash for buying a new dairy cow. Thus, the credit policy does not encourage the purchase of improved dairy cattle. Other forms of asset on most of these farms include a few head of cattle, hand tools and limited ox-drawn ploughs. In general, the limited resource base (land, labour, and capital) seem to discourage the adoption of improved dairy cattle breeds in this area.

Marketing and Input Distribution

The survey results showed that there was no problem of marketing surplus milk in the area studied. All milk produced on farms was consumed as whole fluid milk on these farms or sold to neighbours. There was only one cooperative society that dealt with milk marketing, but it was closing at the time of the survey because there was no adequate supply of milk from farmers. The demand at the farm and

village levels was highly effective. Further, the survey results showed that there was milk shortage every year mainly in November, December, and from January to June in southern Kakamega.

There were three major input supply stores in the surveyed area. For farmers who lived away from these stores, transportation costs for feedstuff, fertilizers, etc., had considerable impact on the availability of these inputs. The other problem was the lack of markets for improved cattle within the area, as reported by the respondents.

The preceding discussion indicates that adopters of European breeds of dairy cattle needed more land, labour, capital and improved management than the non-adopters of these breeds of cattle.

VI. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

A. Summary and Conclusions

The shortage of milk production in Kenya in general, and Kakamega district of Kenya in particular is an important problem now and in the foreseeable future. At present, Kenya is not self-sufficient in milk production. In addition, Kenya lacks adequate foreign curreny to enable the country to import milk to supplement domestic production. Thus, a large proportion of the population in Kenya lack milk, a necessary nutritional item, in their diets. For the past twenty years the Government of Kenya initiated a number of programmes with the objective of increasing milk production on both small and large scale farms in the high rainfall regions. These programs have included introducing European dairy breeds in Kenya, undertaking of research in the management practices of these breeds and improving extension services and credit facilities to farmers keeping improved dairy cows. Despite these concerted efforts by the Government, the production of milk in Kenya, in general, and southern Kakamega, in particular, has not been impressive relative to the efforts of the Government. This study undertook the assessment of the dairy farming system in southern Kakamega.

There were three main objectives of this study. The first was to evaluate the dairy farming system in southern Kakamega in the framework of recommended management

practices from research stations. A second objective was to identify social, economic and technical factors that may have discouraged farmers in this area from adopting improved dairy breeds and management practices. A third objective was to provide some suggestions that are likely to lead to an increase in the rate of adopting and an improvement in the management of dairy animals in this area.

Two sources of data were used in this study; primary survey and published data. As described in Chapter 3 these data were collected using an informal oral interview, followed by a formal written questionnaire of a random sample of fifty three farmers. Published data were mainly from the Ministries of Agriculture and Livestock in Kenya.

To meet the first objective, the existing management practices of both local and improved cattle in southern Kakamega were assessed using survey and published data. The theory of the process of adopting a new innovation, discussed in Chapter 2, provided the framework for a better understanding of some of the variables that affect the adoption of an innovation (improved dairy cows) and the communication process (extension staff). This also involved a description of technical recommendations from Government research stations on the choice of cattle types and farming practices and the extension services available to cattle farmers in this area. Published recommendations on dairy management for the whole country were used in this study since there were no recommendations on dairy management

specific to Kakamega farmers.

The second objective was met by assessing, using data from a sample of farmers, factors that seemed to influence the choice of cattle types and management practices which followed. Specific problems faced by adopters and non adopters of improved cattle were identified through the oral interviews that were done during the informal and formal surveys.

As outlined in Chapters I and III southern Kakamega was studied because it is one of the most densely populated area in Kenya and the need for increased milk production was evident. Also, this area has been one of the "special rural development projects" where the Government of Kenya has spent considerable amount of funds and efforts to improve agricultural production, with little success.

The first conclusion of this study is that purchase and management of improved dairy cows placed a heavy demand on the limited resources available on farms in this area compared to the demand of local cattle types. In addition, the risks from death, lack of organized markets and theft discouraged the keeping of improved cows in this area. Thus, most farmers did not perceive the net benefits of improved cows over local cattle. Most farmers preferred local cattle over improved breeds because of the high degree of disease and heat resistance. Also local cattle have a better ability to withstand stress (walking over long distance in search for water and grass) than improved cows. Another apparent

advantage of the local cattle types was their small bodies compared to most improved cattle. Thus, local cattle required less feed and water than improved breeds such as the Friesians, Guernseys or Ayrshires. Also markets for the sale and purchase of local cattle were readily available because of the preferred features of local cattle as perceived by farmers. The market for the sale and purchase of improved cattle was very limited in southern Kakamega. Adopters of improved cows contended that the high level of milk production was a major advantage of these breeds. However, the farmers stated that for this goal to be attained the level of management had to be high. Also, the high risk of losing an improved cow through death and theft discouraged keeping these breeds. Farmers did not perceive the advantage that offsprings of improved cattle have faster growth rates than those of local cattle. In general, considering the technical and economic aspects of this innovation (improved dairy cattle), it is concluded that most farmers in southern Kakamega have not perceived the net advantage of keeping improved dairy cows. It does not seem that the adoption rate of improved dairy cows is likely to increase.

The second main result, which is closely related to the one outlined above, was that the resource base (land, capital and labour) of farmers limited the introduction of improved cattle. The small land size, averaging 2.5 acres per family, was the most limiting resource. As shown in

Chapter V, food and cash crops were given priority for land use over cattle. Cattle were restricted to the grazing land around the homesteads and along the roadside. Even for those few farmers who allocated some extra land for cattle use the land was not adequate. In addition, much of the pasture around the homesteads was not improved and usually withered during the dry season. The study showed that most farmers had limited fixed and current assets Adopters of improved cattle had some extra cash mainly from off-farm employment and from the sales of surplus farm produce. Thus, adopters were able to purchase some drugs and feeds for cattle. Most non-adopters had some meagre income from the sale of cash crops. However, this was not available for the purchase of inputs for dairy cattle production. Most of the farmers used mainly family labor in the management of their cattle and other farm activities even though adopters of improved cattle required and often hired a full time worker to manage cattle. As shown earlier, most of the farmers (both adopters and the non- adopters of improved cattle) had no formal training in basic agriculture and livestock management. Thus, most recommended dairy management practices, such as keeping records and feeding the cows were sub-optimal. It is concluded that the adoption of improved dairy cows on farms in this area may not be compatible with the limited resources available. It is not likely that the rate of adoption may increase in future.

The results seem to show that social factors do not limit the adoption of improved cattle. On the other hand, the limited extension services (veterinary, artificial insemination and animal nutritionists) seem to discourage the adoption of improved breeds in this area.

It should be noted that the improved breeds of dairy cattle in Kenya, have performed well in the highlands where climatic conditions are temperate, land can be allocated to dairy animals and farmers can afford purchased feeds. These improved cows have also perfomed well in lowland, high rainfall areas provided that feeding and disease control practices are adequate. The results of this study show that this is not the case in southern Kakamega. It is shown that there are a number of bottlenecks. First, due to poor disease control, the risk of animals dying is high and the investment is too large compared to local cattle. Another bottleneck is that the demand on management skill is high and the land and capital requirements are such that only farmers with a broader resource base adopt this innovation. This study implies that this innovation is suited to farmers with land size of over 5 acres and with a regular source of off-farm income.

B. Recommendations

Based on results from this study, the following recommendations are made for the improvement of dairy production in southern Kakamega.

1. Breeding:-

It is recommended that a breeding program should be undertaken to provide suitable crossbreds from improved bulls and local cows. This is necessary to introduce disease, heat resistance, and hardiness in the cross while retaining the high productivity of the animal. Breeding work on the genetic composition of improved and local cows should be carried out for several generations, comparing milk yields, disease resistance, feed and water needs. Results of studies associated with cross-breeding in India for example, have shown that there is increased milk production and lactation length with crossbreds ranging from three eighths to three quarter Friesian grades.[1] In addition, location specific research should be done on existing improved pure breeds of cattle to determine which breed is most appropriate to the resources available in this area. For example, the Jersey breed is more resistant to high ambient temperatures and has a lower body weight, thus requiring less feed for maintenance than the rest of the temperate dairy breeds.

2. Disease Control:-

A well adminstered disease control campaign should be enforced in all sub-locations in southern Kakamega.

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[1]For more details on cross-breeding in India, see B.G. Katpatal,"Dairy Cattle Cross-breeding in India" in a *Quarterly Journal Devoted to Animal Production, Animal Health and Products* No.22 (1977): p. 15.

Existing dips should be well maintained before new ones can be constructed in the same area. If possible, a central spray race should be established for demonstration of how to spray cattle for control of ticks.

3. Nutrition Management:

It is recommended that research be undertaken to assess the possible application of zero and minimum grazing under the existing farming system.

There should be a provision of readily available water on farms, using tanks and bore holes which are relatively inexpensive. This is necessary to limit the extra walking of animals as well as to limit the danger of contact of diseases.

4. Research:-

Ways to develop research recommendations for farmers with local animals should be investigated. The present dairy research is too general. It is important that research be conducted under local conditions of farmers in southern Kakamega because the current recommended dairy practices do not fit in the existing farming system.

5. Extension services:-

Aspects of dairy management should be included in the current farmer training programme. Further, there should be frequent in-service training for the dairy extension staff, particularly those in contact with the farmer. It

is also recommended that better veterinary facilities and extension services be available to dairy farmers in southern southern KaKamega.

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APPENDIX

The parts of the questionnaire used for this study are marked by asteriks.

WARS[1] KAKAMEGA MAY 1980

FARM SYSTEM DAIRYING QUESTIONNAIRE PAGE 1.

Date completed _____ Serial Number _____

Sub Location _____ Village _____

Name of Enumerator _____

Name of Farmer _____

Is this farmer? Original Sample _____

Replacement _____

Other? _____

GENERAL Ishould like to ask some general questions about you and your family.

*1. How long have you been operating this farm?

less than 2 years	2-5 years	6-10 years	more than 11 years

*2. How many people live in your household? _____

*3. How many of these are under 13 years old? _____

*4. Are any of these people living in the household employed off the farm, if so how many? _____

*5. What work does each do? Indicate whether it is full or part-time

	Work	Full or Part-time
1st person		
2nd person		
3rd person		

*6. Have you or your wife ever attended a course at the Farmer's Training centre?

Farmer Yes/No Wife Yes/No.

*7. If so what course(s) were attended

Farmer_____

Wife_____

LAND USE Ishould now like to ask you some questions about the land that you farm.

SKETCH THE FARM BEFORE ASKING Q8 to 22. SHOW CROP ARRANGEMENTS.

GO TO THE MAIN MAIZE PLANTING TO ASK Q10 TO 22.

*8. What is the total area of your farm?_____

*9. Of this total area, at present, how much is under crops, how much under grass and trees or bush.

Food crops_____ Cash crops_____

Homestead_____ Uncultivated (good)_____

Uncultivated (waste)_____ Grass_____

Tree or bush_____

10. Can we detail the crops you planted for the last short rains, this is in the second half of 1979?

Crop	Field No.	Land prepared Method/Month By H,O,T.	Approx Acres or Ha. plant	Planting Month Early or late	Crop last Season	Mixed with	fert. manu. noth. F,M,N	Mo. cro used fro fld	Mo. har ves E/L
Local maize	1								
	2								
Hybrid maize	1								
	2								
Beans	1								
	2								
	3								
	4								
Cowpeas									
Sw. pot.									
Other annuals	1								
	2								
	3								

SKETCH OF THE FARM

11. Can we detail the crops you have in the ground now, in this long rains season. (GO TO THE MAIN MAIZE PLANTING TO ASK Q 10 TO 22.)

Crop	Fld. No.	Land prep. method/mo. By H,O,T,	Approx acres or Ha	Planting month Early or late	crop last season	mixed with	fert. manu. noth. F,M,N	mo. crp. use fro fld	mo. har-vst or L
Local maize	1								
	2								
Hybrid maize	1								
	2								
Beans	1								
	2								
	3								
	4								
Cowpeas	1								
Sw. pot.									
Other annuals	1								
	2								
	3								

*12. Which permanent crops, trees and grass, do you have on the farm?

(napier recorded as I=improved or L=local. Improved pasture recorded as K=Kikuyu, R=Rhodes, S=Star grass)

Crop	coffee	tea	banana	paw paw	sugar	napier I or L	improved K,R,S.	other specify
Year and month establish								
Approx acres or No. trees								

13. Could you give me more details about how you grow your maize, in both the long and the short rains?

(a) Have you bought any fertilizer for your crops since christmas 1979?

(b) If so how many bags of fertilizer have you bought since christmas 1979?

14. What types have you bought, and how many bags of each?

DAP_____bags, TSP_____bags, SSP_____bags, DSP_____bags,

CAN_____bags, SA_____bags, ASN_____bags, CPD_____bags.

15. What type and how many bags did you apply to your LR maize at planting? Type_____ _____bags._

16. What type and how many bags did you use for top dressing your LR maize? Type_____ bags_____

17. Did you apply any insecticide to kill stalk borer for your LR maize? If so what kind_____

18. PICK A SPOT IN THE FIELD

(a) Measure the distance between two rows of maize_____

(b) Over 5 plants in the row_____

(c) How many bean plants are there over this distance between the row

(d) Where are they placed_____

Check whether he planted maize in the Short Rains before asking:-

19. Did you apply fertilizer or manure to your last Short Rains? maize crop? Seed bed fertilizer: Type_____bags_____

Top dressing: Type_____bags_____ Manure_____

20. Did you apply any insecticide to kill stalk borer in the Short Rains crop, if so what kind?_____

21. Could you estimate how many bags of shelled maize you produced from the Short Rains crop?_____

LIVESTOCK

I should like to go on and discuss your livestock.

*22

*22. What kind do you own? Grade[1] cattle_____ Cross_____
Local cattle____sheep_____goats_____ Pigs_____
Improved poultry_____ Local poultry_____

*23. Can you tell me details about the kind of cattle you have here on your holding? FILL TABLE BELOW:-

*(b) What is the purpose of keeping cattle on your farm?_____

[1]Grade cattle refers to improved cattle in this study.

Pests, diseases and their control: Now let us talk about pests and diseases.

*34. How many of your cattle have died over the last 18 months, since Christmas 1978?_____

*35. Can you give me the breed, age and sex of each, including calves, and the reason for its death.

	Breed	Age	Sex	Reason
1.				
2.				
3.				

*36. How do you control the ticks on your animals?
Pick off_____ Dipping_____ Spray_____

*37. How frequently do you apply these control measures?_____
If he does not dip, why not?_____
If dipping is answer in Q36, continue

*38. How far is the dip to which you take your animals?_____miles.

*39. Is this the nearest to your home? Yes/No
If so, why do you go to one which is further away?
_____

*40. Which period of the year is dipping a problem for you? (month)__
If spraying is the answer in Q36, continue
Do you own pump or use someone else's?_____ What make is it?_____
*41. Which spray chemical do you like best?_____and why?_____
Do you own pump or use someone else's?_____What make is it?___
*42. Is it easy to get this chemical? Yes/No.
If not, what is the problem?_____

*43. Which chemicals are easy to get?_____
DAWA[1]

*44. Do you ever give your animals dawa to get rid of worms? Yes/No
If so, how frequently?_____
Where source_____

*45. Is this dawa easy to obtain when needed?_____

*46. If you have a very sick animal do you contact Bwana Ng'ombe?[2]
Yes/No____

*47. If not, why not?_____

*48. Which diseases do you treat with herbs?_____

[1]DAWA refers to deworming drug

[2]Bwana Ng'ombe is a veterinarian

Feed Management

*49. Which sources of food do you use for your cattle?
(Read sources in Table to farmer and tick as appropriate)

*50. Which are the most important four of these?

*51. Which months do you use each of these sources of feed you have mentioned?

Source	Tick if used Q49; use	Tick 4 most important Q50; important	Period of use Q51: months All yr	J	F	M	A	M	J	J	A	S	O	N	D	Alt Use
Grazed your farm																
Grazed common land																
Grazed other farm																
Maize green																
stalk dry																
Maize leaves green																
Maize tops (green)																
Banana leaves																
Banana stems																
Cut grass																
Brewery waste																
Sugar tops																
Purchased feed																
Other																

*52. Of the feeds other than grass, which do your cattle prefer?_____

*53. Which months are the most difficult for feeding your cattle?____

*54. Is this month difficult every year or only occasionally?_____
If occasionally, which was your last bad year?_____

*55. Do you ever sell fodder to other farmers?_____
if so, what type and what year/month was your last sale?_____

*56. Do you ever buy fodder from others? Yes/No_____
If yes, what type and what year/month was your last purchase?____

*57. When your cattle are grazing are they tethered?_____
,Always_____ Sometimes_____ Never_____
If always or sometimes what are the reasons for tethering?____

*58. How many hours in the day are cattle grazed in the following months? March_____ May_____ November_____

*59. Fill in the questions on the sources of water in the rainy and dry seasons.

Season	Distance home	miles	Months used	Cattle driven	Water carried	Frequency watered/day
Dry						
Wet						

*60. When water is carried to the cattle about how much is given per day (debes)?[1]

Dry Season	Wet Season
____debes	____debes

*61. Do you house your cattle at night?_____
If so, inside under a roof (house)_____
Outside boma_____Other specify_____

*62. Do you use bedding in the house? Yes/No_____
If so, answer some questions on bedding.
What material is used?_____
Is it used all year round, if not specify periods used?_____
How often is bedding changed?_____

*63. Do you use bedding and manure on crops?_____
If so, which months_____ and which crops_____

*64. Where are your animals milked?_____

*65. How does the milker prepare for milking: (N. B. Washing hands, washing udders, grease udders, gives feed to cow, suckling calf)?_____

*66. How long does milking take from getting ready to starting other work: Morning_____Night_____

*67. How do you feed your calves?Suckles_____Bucketfeeds_____
(a). If calf suckles, is this before or after milking?_____

*68. If calves are bucket fed- how soon after milking is this done done?_____

*69. If calves are bucket fed, how many kimbo tins[2] of milk are fed to calf at: One month_____3 months____ 6months____ 8months____

*70. What ages do calves stop drinking milk (in months)?_____

[1]One debe contains eighteen litres of fluid (water)

[2]One kimbo tin contains two kilogrammes of solid matter (feed)

Class	Type & Number now: Local L	Cross C	Grade Fre. Jer Ayr. Gue	During last year: Bought No.	Bought cost	sold No.	sold Month	sold price	No. died	No. of AI service during last year
Bulls										
Oxen										
Calves M										
F										
Heifers										
Milking cows										
Dry cows										

*24. Do all these cattle belong to you?_____ If not which belong to others?_____

*25. Do you own cattle which are kept in another place?_____ If so, how many and what type?_____

*26. Why not keep them here at home?_____

*27. Please give me details about the two cows you have had the longest. (Take one at a time). If farmers have grade and local cows, do one of each.

Breed	bought Yr.	bought Age	Born yr.	yr. of last calf	number of calves died/live	Month last calf	Bottles milk produced yesterday	If not in milk condition
1.								
2.								

Breeding Management

*28. How do you breed your cows:
Own bull_____ Bull from another farmer_____AI_____

*29. Do you believe AI has problems? If so, what are they?
Calves often die_____ No choice of bull_____
AI crush is too far_____Don't like crosses_____
Too many services_____Don't know about it_____
Other (elaborate)_____

*30. If farmers answer 'calves often die' or'Don't like crosses' or or 'No choice of bull', ask them to elaborate._____
_____

*31. Is there one period in the year when it is best for your cows to have their calves? Months_____

*32. Why is this the best period?_____

*33. Do you breed your cows to have their calves at this time?_____

LAND, LABOUR AND CASH PROBLEMS Ishould like to ask you a few questions to find out whether you have problems with shortage of land and with shortages of labour and cash at certain times of the year.

*71. Do you ever rent or borrow land from other farmers?_____

*72. Do you lend some of your land out to others?_____

*73. Could you buy land if you needed it?_____

*74. If so, how far away from your own house?_____

*75. If you obtained more land what would you use it for mainly?
_____ Doesn't want more?_____

*76. Which month of the year is the busiest for you and your family?
_____

*77. What is the main work you are doi ng at that time_____

*78. What is the second busy month at another time of the year?____

*79. What work are you and your family doing then?_____

*80. Have you hired any labour during thislong rains season?
If so, for what work on which crop (s)?_____
_____

*81. Did you hire any labour during the last short rains season?
If so, for what work on which crop(s)?_____
_____

*(b). Do you have any permanent labourers? If so how many?_____
_____

CASH SOURCES
Let us talk about the main sources of cash.

*82. Do you get cash from any of the following sources? and which periods of the year do you get cash from these sources?

Cash	Tick source mentioned	Rank 4 most important	Period of the year w when cash available (month)
Tea			
Coffee			
Banana			
Maize			
Beans			
Other crop produsts			
Off farm work			
Family away			
Cattle			
milk sold			

*83. At which time of the year is finding cash a problem for you and your family(months)?_____

*84. What do you mainly need cash for at this problem time?_____

*85. At this problem time what sources are you able to get cash from?
_____

GENERAL
Finally I have a few more general questions to ask.

*86. Are there some months when you have no milk for the family?____
If so, which are these?_____
Why is this ?_____

87. Does your farm usually produce enough maize to supply food until the next harvest?_____

88. Which year and month did you last run out of home produced maize?_____

89. What did you eat until the new harvest and where did you get it?
_____

90. Do you think families are eating bananas more than previously?
Will bananas ever replace maize?_____
Why or why not?_____

*91. Have you ever had grade cattle before?___Yes/No_____
*(b) What do you feel about grade cows, what are the most difficult problems with them?_____

*92. Does the need for grazing during October, November, prevent you from planting crops in the short rains?_____Yes/No_____
*b) Do you think conserving grass or fodder during wet season would be useful to farmers with grade cattle in the dry season? Yes/No_____
*c) Do you think a breed of cattle which is a cross between local cow and grade bull (AI) is a useful to farmers in this area?___ Yes/No_____
OR Pure grade cow? Yes/No_____
*d) Do you think there is need for improved pasture in this area? Yes/No_____If yes, which improved pasture types do well here?_____

*93. Do you think a maize which was ready three or four weeks earlier than the hybrids would be useful to farmers in the area?Yes/No
If so, why?_____

Thanks very much for your help, it will help us to design some research programmes which we hope will bring methods to improve your production and income.

c.2

c.2

THESIS - 1983
M.Sc.

A SOCIO-ECONOMIC ANALYSIS OF ADOPTION OF EUROPEAN BREEDS OF DAIRY CATTLE IN S.KAKAMEGA, KENYA